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ABSTRACT

One of the most important provisions of Act 750 of the 1979 Louisiana Legislature is the mandated development and establishment of statewide curriculum standards for required subjects for the public elementary and secondary schools. The 1986 revision of the Louisiana standards for mathematics recognizes the need to move from minimum to on-grade-level expectations for all children. This curriculum guide has been organized to reflect the emphasis on problem solving. The first part, "Curriculum and Standards," lists the domains, standards, and skills for all grades. The second part, "Problem-Solving Process and Strategies," provides teaching materials for 13 strategies. The last part presents instructional activities for 10 domains: sets; numeration; whole number operations; fractions and operations; decimal numbers and operations; percent, ratio, and proportion; measurement; geometry; graphs, probability, and statistics; and pre-algebra. The appendices contain a list of suggested manipulatives and an index to curricula and standards. There are 24 references. (YP)

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STATE OF LOUISIANA
DEPARTMENT OF EDUCATION

ATHEMATICS CURRICULUM GUIDE

GRADES K-8

BULLETIN 1609
Revised 1986

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STATE OF LOUSIANA

DEPARTMENT OF EDUCATION

MATHEMATICS CURRICULUM GUIDE
GRADES K - 8

Bulletin 1609

Revised 1986

Issued by

Office of Academic Programs

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FOREWORD

Act 750 of the 1979 Louisiana Legislature (R.S.17:24.4) established the Louisiana Competency Based Education Program. One of the most important provisions of Act 750 is the mandated development and establishment of statewide curriculum standards for required subjects for the public elementary and secondary schools. In addition, this legislation provided for the development of curriculum guides which contain lists of skills and competencies and suggested classroom activities. Further, Act 750 mandated the establishment and the implementation of a procedure for the continuous improvement of the goals of education in the State.

Subsequent to the enactment of the competency-based education legislation, curriculum guides were developed for all required subjects by advisory and writing committees representing all levels of professional education and all geographic areas across the State of Louisiana. Following their development, the guides were piloted by teachers in school systems representing the different geographic areas of the state as well as urban, suburban, inner city, and rural schools. The schools and classrooms involved in the pilot program reflected also the ethnic composition of Louisiana's student population.

In keeping with the mandate to establish and implement a procedure for the continuous improvement of the goals of education in the state, a task force representing all levels of mathematics education and all geographic areas of the state was appointed to work with Departmental staff and a consultant in education and measurement in the review and the upgrading of the mathematics standards and the curriculum guides. This process required two years for completion and involved not only the task force, departmental staff, and the consultant, but also 2,500 mathematics teachers, K-12.

The grade-level standards and the curriculum guides are now ready for statewide implementation. The completion of this particular step in the procedure for continuous review and improvement of the goals of education in the state ensures an appropriate, relevant, and comprehensive mathematics curriculum for each student in the public schools of Louisiana.

Thomas G. Clausen

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RATIONALE

The 1986 revision of the Louisiana standards for mathematics recognizes the need to move from minimum to on-grade-level expectations for all Louisiana children. Public demand for excellence has prompted the Board of Elementary and Secondary Education to increase the number of Carnegie units required for graduation from high school, to specify more rigorous courses that the prospective graduate must complete, and to plan a pre-graduation test. In order to prepare students to meet these challenges, teachers at each grade level must give consistent attention to the mathematics skills set forth in this document.

This curriculum guide has been developed and organized to reflect a major philosophical emphasis on problem solving which the committee believes must underlie all mathematics instruction. Research has shown that the teaching of specific problem-solving strategies increases students' ability to solve problems as well as to compute. Two features of the guide reinforce this philosophy:

1. Most domains within the curriculum specifically include a separate standard on problem solving, involving skills in solving word problems and critical thinking problems.

2. A list of 13 problem-solving strategies applicable to all domains of the mathematics curriculum has been developed. Students may use a variety of these strategies to solve problems of various kinds. A special section on activities that promote learning of problem-solving strategies precedes the instructional activities for the separate domains.

Beyond this basic philosophy, emphasis has also been placed on developing concepts concretely. Students should have a variety of opportunities to use manipulatives in exploring concepts before progressing to the abstract. A list of suggested materials is presented at the end of the guide.

Finally, it should be noted that standards for Algebra I have been included for the first time in keeping with increased graduation requirements. Skills identified as essential for success in algebra have been included in the new domain Pre-Algebra. Activities for Algebra I may be found in the separately published Algebra I Curriculum Guide.

HOW TO USE THIS GUIDE

The principles presented in the rationale provide the philosophical basis for this guide. The guide sets forth the revised curriculum, the new standards, and instructional activities to support use of the program in the classroom. There are several important features of this new guide:

1. The grade-level standards have been embedded in the curriculum in a single unified framework to facilitate use by teachers for whom the guide was designed.

2. The framework has been constructed so as to facilitate articulation in course content across grade levels. It is organized to show the building of skills from the simpler to the more complex.

3. New terminology has been adopted to correspond with the new framework:

   Domains: broad divisions of course content representing traditional areas of the mathematics curriculum; labeled with Roman numerals

   Standards: broad instructional objectives representing major learner outcomes for the program; labeled A, B, C, etc. in each domain

   Skills: specific objectives which describe what the student must learn in order to develop proficiency with respect to the standards; labeled with two-digit Arabic numerals within each standard

   Proficiency: on-grade-level competence with respect to a skill; this term replaces the term "mastery"

   Introductory Grade: the grade at which students should be exposed to initial instruction on the skill; entered in columns headed **Int**

   Proficiency Grade: the grade at which students will first be expected to demonstrate competence on a skill; *multiple* proficiency grades are given for skills which increase in sophistication over time; proficiency grades are entered in columns headed **Prf**.

Using the Curriculum and Standards

The **curriculum** is presented in the next section of the guide. It contains a list of the **domains, standards, and skills** for all grades, K-12. In the columns next to the skill statements are corresponding introductory (**Int**) and proficiency (**Prf**) grades. Skills which do not have assigned proficiency grades are properly part of the curriculum, but are not part of the required standards; these skills are shown with an asterisk (*) in the proficiency grade column. Responsibility for on-going development of skills is to be assumed by teachers of the grades following the introduction and preceding the proficiency grade. Similarly, responsibility for maintenance of skills is to be assumed by teachers in grades following the proficiency grade.

The **sequence** of skills in the curriculum follows conventional order, but is not patterned after any particular mathematics textbook. However, the skills may be found at the same grade levels in most of the mathematics textbooks on the state-approved list. The conscientious teacher will use the course content as a framework upon which a year's instruction may be built.

The format of the curriculum serves as an **index** to the guide. The final column shows the pages on which one or more relevant instructional activities will be found. Page numbers appearing first generally will refer to activities *primarily* targeted on the given skill; those later in the list may indicate activities which give secondary attention to that skill in connection with teaching some other skill.

In the body of the guide, each activity is placed within the domain of its primary target skill. The activities within a domain are sequenced by skill and numbered consecutively. Each activity is coded to indicate the skill or skills to which it is matched. The **codes** (e.g., IV-A, 05) appear above the sequence number and represent the relevant domain, standard, and skill, respectively. The teacher looking for an activity to teach a skill should refer to the page numbers shown in the index, then scan the page for the skill code number.

The instructional activities for each domain are preceded by a special section on the **problem-solving process and strategies**. The teacher is encouraged to use problem solving as a vehicle for teaching all skills in the curriculum. Instructional activities for each of the 13 strategies are included.

Using the Instructional Activities

The instructional activities have been developed to support the curriculum and are given as **samples** to illustrate an integrated rather than isolated approach to skills development. The activities vary in difficulty and are designed to meet the needs of a variety of learners.

Given varying ability levels of students, most activities will apply to more than one grade level. The activities therefore represent a pool of instructional ideas from which the teacher may draw. It is the responsibility of the teacher to select the activity most appropriate for the learner. The teacher may adjust the on-grade curriculum for students performing below or above grade level by selecting appropriate skills and by selecting activities and instructional materials relevant to the students' level.

The general features of each activity are described. Examples indicating how to implement the activity are often given and, as an aid to the teacher, the correct answers are often shown (in parentheses) with the examples.

Some skills do not have associated instructional activities in the guide. This generally reflects the intention to avoid duplication of instructional material that is widely available in current textbooks. It is expected that teachers will inventory learning activities in textbooks and supplementary materials to compile a comprehensive set of instructional ideas for each skill. A variety of learning activities should be used to meet fully the needs of all students and to broaden and enrich their classroom experience.

Using the Supplementary Materials

A **list of suggested manipulatives** is provided at the end of the guide in the interest of fostering the use of concrete experiences in teaching mathematics. The teacher is encouraged to review this list with the aim of making a variety of manipulatives available in the classroom.

The last section of the guide is a **bibliography** which represents the sources from which many of the activities in the guide were drawn or adapted. The teacher is encouraged to use these references as sources for additional instructional ideas.

CURRICULUM AND STANDARDS

I. SETS

I-A: Understands the concept of sets.

		Int	Prf	Page
01	Identifies and describes concrete and semi-concrete objects that are the same or different.	K	K	1
02	Recognizes a set of concrete objects from a given description (e.g., boys in a class, girls in a class).	K	K	1, 2
03	Identifies members (elements) of a set.	K	K	1, 2
04	Identifies an empty set.	K	K	3, 4
05	Recognizes and describes related and non-related objects in a collection.	K	1	2

I-B: Understands cardinal numbers.

01	Recognizes the cardinal number of a set of not more than ten members (elements).	K	1	4, 5
02	Matches a numeral with the number of members (elements) of a set (not more than ten).	K	1	4, 5, 8
03	Writes the cardinal number of a set of not more than ten members (elements).	K	1	4, 5
04	Writes the cardinal number of a set of more than ten members (elements).	1	1	4, 5
05	Recognizes zero as the number of members (elements) in the empty set.	1	1	4, 5

		Int	Prf	Page
06	Adds members to make a set contain a specified number of members (limit to a total ten members).	1	1	5

I-C: **Orders and compares sets**.

		Int	Prf	Page
01	Matches concrete and semi-concrete objects in a one-to-one correspondence (sets of not more than five members or elements).	K	K	6
02	Compares the number of members (elements) in two sets and indicates which has more or fewer (sets of not more than five).	K	K	6, 7
03	Identifies a set that is equivalent or non-equivalent to a given set.	K	1	6, 7, 8
04	Sequences sets in ascending or descending order of cardinal number (sets of not more than ten members or elements).	K	1	8
05	Constructs a set of concrete or semi-concrete objects having one more or one less than a given set (sets of not more than ten members or elements).	K	1	8

II. NUMERATION

II-A: **Demonstrates counting skills**.

		Int	Prf	Page
01	Counts concrete and semi-concrete objects (1 -10).	K	K	9
02	Counts to 10 by ones.	K	K	10

		Int	Prf	Page
03	Counts to 100 by ones, twos, fives, and tens.	1	1	10

II-B: Reads and writes number symbols and words.

01	Recognizes number symbols 1 to 10 in sequential and random order.	K	K	11, 12, 9, 10
02	Writes number symbols 0 to 10 in sequential order.	K	1	12
03	Reads and writes any number symbol 0 through 100.	1	1	12, 13
04	Reads and writes any number symbol 101 through 1,000.	2	3	13, 14
05	Reads and writes any number symbol 1,001 through 10,000.	3	4	13, 14
06	Reads and writes any number symbol 10,001 through 100,000.	4	5	13, 14
07	Reads and writes any number symbol 100,001 through 10,000,000.	5	6	14, 15, 24
08	Reads and writes number words zero through ten.	1	2	12, 13
09	Reads and writes number words for multiples of ten (twenty through ninety).	1	2	13
10	Reads and writes number words eleven through nineteen.	2	3	13
11	Reads and writes any compound number word through one hundred (e.g., twenty-nine).	2	5	13, 15

		Int	**Prf**	**Page**
12	Reads and writes any number word one hundred one through millions.	4	6	13, 15
13	Reads and writes number words billion and trillion.	5	*	13, 15 29

II-C: **Reads and understands ordinal numbers.**

01	Identifies positions of objects or pictures corresponding to ordinal numbers through tenth (numbers given orally).	K	1	16, 17
02	Reads ordinal numbers and identifies corresponding positions through 10th.	1	2	16, 17
03	Reads ordinal numbers and identifies corresponding positions 11th through 19th.	2	3	16, 17
04	Reads ordinal numbers and identifies corresponding positions 20th through 100th.	3	4	17

II-D: **Understands whole number sequences and patterns**.

01	Continues a pattern from a given sequence of concrete or semi-concrete objects.	K	1-8	18
02	Supplies a number that is one more or one less than a given number (1-99).	1	1	19
03	Supplies a number that is one more or one less than a given number (100-1000).	2	3	19
04	Sequences numbers by ones through 100.	K	1	19, 20
05	Sequences numbers by ones 101 through 1,000.	2	3	19, 20

		Int	Prf	Page
06	Sequences numbers by ones 1,001 through 10,000.	3	4	19, 20
07	Sequences numbers by ones 10,001 through 100,000.	4	5	19, 20
08	Sequences numbers by ones 100,001 through 1,000,000.	5	6	19, 20
09	Sequences odd or even numbers (0 through 99).	2	3	19, 20
10	Sequences odd or even numbers (100 through 1,000).	3	4	19, 20
11	Sequences numbers that are multiples of 5 or 10, through 100.	2	3	19, 20, 21
12	Supplies missing numbers in a whole number sequence or pattern requiring either addition, subtraction, multiplication, or division.	5	7	20, 21

II-E: Understands whole number equalities and inequalities.

01	Identifies and uses the symbols +, -, and = in whole number sentences.	1	1	22, 23
02	Identifies and uses the symbols x, ÷, and = in whole number sentences.	3	4	22, 23
03	Compares two whole numbers between 0 and 99 using "greater than" and "less than" (no symbols).	1	2	23, 24, 36
04	Compares two whole numbers 100 -10,000.	2	4	23, 24, 13

		Int	Prf	Page
05	Compares two whole numbers 10,001 - 10,000,000.	4	6	24, 15
06	Identifies the symbol for greater than (>) and less than (<).	1	3	24
07	Applies mathematical symbols (>, <, =, ≠) to state an equality or inequality (e.g., 5 < 9).	3	4	24, 25
08	Compares two number expressions by placing the symbol >, <, =, or ≠ between them (e.g., 5 + 3 > 3 + 2).	4	6	25
09	States which of a given set of equalities or inequalities is true.	3	4	26

II-E: Understands place value in whole numbers.

01	Groups concrete and semi-concrete objects in groups of ten (limit to ten groups).	K	1	27
02	Recognizes place value: ones and tens.	1	2	27, 28, 29, 24
03	Recognizes place value: hundreds.	2	2	27, 28, 29, 30, 24
04	Recognizes place value: thousands and ten thousands.	3	4	27, 28, 29, 30, 23, 24
05	Recognizes place value: hundred-thousands.	4	5	28, 29, 30, 24
06	Recognizes place value: millions	5	5	28, 29, 30

		Int	**Prf**	**Page**
II-G	**Rounds whole numbers.**			
01	Rounds numbers to nearest 10.	3	4	31, 32, 113
02	Rounds numbers to nearest 100.	4	5	31, 32, 113
03	Rounds numbers to nearest 1,000.	5	6	31, 32
04	Rounds numbers to any specified place value: thousands through millions.	6	7	32
II-H	**Understands Roman numerals.**			
01	Reads and writes Roman numerals (for 1-50).	4	6	33, 34
02	Identifies the Roman numerals C, D, and M.	4	6	33, 34
03	Understands the three principles involved in Roman numerals: repetition, addition, and subtraction.	4	6	33, 34
II-I	**Understands factors, multiples, and composites.**			
01	Recognizes odd and even numbers.	2	3	35, 24
02	Recognizes numbers that are (evenly) divisible by 2, 3, 5, and 10.	3	5	35, 36
03	Recognizes numbers that are (evenly) divisible by 4, 6, 9, and 11.	5	6	35, 36
04	Defines and identifies prime and composite numbers.	5	6	36

		Int	**Prf**	**Page**
05	Identifies the factors and prime factors of a number not greater than 50.	5	6	37
06	Identifies the factors and prime factors of a number (51-100).	5	*	37
07	Writes a number as the product of its prime factors (prime factors 17 or less).	5	6	38
08	Finds common factors of two or more numbers.	5	6	--
09	Defines and distinguishes between least common multiple (LCM) and greatest common factor (GCF) of two or more numbers.	5	6	40
10	Determines the greatest common factor of two or more numbers.	5	6	38, 39, 40
11	Finds common multiples of two or more numbers less than 30.	5	6	39
12	Determines the least common multiple of two or more numbers.	5	6	39, 40

III. WHOLE NUMBER OPERATIONS

III-A:	Adds whole numbers.			50
01	Adds one-digit numbers (sums 0-12) using concrete objects.	1	1	41, 42, 51
02	Adds one-digit numbers (sums 0-10).	1	1	42, 43, 44
03	Adds one-digit numbers (sums 11-18).	1	2	42, 43, 44

		Int	Prf	Page
04	Adds three one-digit numbers (sums 0-10) with mental and written computation.	1	1	44, 45
05	Adds four one-digit numbers (sums 0-36) with mental and written computation.	2	3	44, 45
06	Adds a two-digit and a one- or two-digit number using concrete objects (no regrouping).	1	2	45, 51
07	Adds two numbers with zero in one of the two addends (sums to 99).	1	2	47
08	Adds a two-digit and one- or two-digit number (no regrouping).	1	2	46, 47
09	Adds a three-digit number and one-, two-, or three-digit number (no regrouping).	2	2	47
10	Adds a column of three or four two-digit numbers (no regrouping).	2	3	45, 47
11	Adds a two-digit and a one- or two-digit number using concrete objects, with regrouping.	2	3	45, 46, 47
12	Adds a two- or three-digit number and a one- or two-digit number, with regrouping.	2	3	46, 47, 48
13	Adds a three-digit number and two- or three-digit number, with regrouping.	3	3	47
14	Adds three three-digit numbers, with regrouping.	3	4	45, 47
15	Adds two four- or five-digit numbers, with regrouping.	4	4	47
16	Adds a column of up to four addends with varying numbers of digits (maximum of three), with regrouping.	3	4	45, 47, 48

		Int	Prf	Page
17	Adds a column of up to five addends (with varying numbers of digits (maximum of five), with regrouping.	4	5	48
18	Identifies the parts of an addition problem: addend, sum.	1	3	42, 49
19	Understands the concept of zero as the "identity element" in addition.	1	3	42, 49
20	Checks sums by adding in reverse order.	1	*	42, 44, 50, 55

III-B: Subtracts whole numbers.

01	Subtracts a one-digit number from a one- or two-digit number (minuends 12 or less), using concrete objects.	1	1	51, 52, 47
02	Subtracts a one-digit number from a one- or two-digit number (minuends 10 or less).	1	1	51, 44
03	Subtracts a one-digit number from a one- or two-digit number (minuends 11-18).	1	2	51, 44
04	Subtracts a one-digit number from a two- or three-digit number (no regrouping).	1	2	52
05	Subtracts a two-digit number from a two- or three-digit number (no regrouping).	2	2	52
06	Subtracts a three-digit number from a three-digit number (no regrouping).	2	2	52
07	Subtracts a one- or two-digit number from a two-digit number using concrete objects, with regrouping.	2	3	52, 53

		Int	Prf	Page
08	Subtracts a one- or two-digit number from a two-digit number, with regrouping.	2	3	52, 53, 54
09	Subtracts a one-, two-, or three-digit number from a three-digit number, with regrouping.	3	4	52, 54
10	Subtracts a number of four digits or less from a four-digit number, with or without regrouping.	3	4	52, 54
11	Subtracts a four- or five-digit number from a five- or six-digit number, with or without regrouping.	5	5	52, 54
12	Subtracts zero from any two-digit number.	1	2	54
13	Subtracts two numbers with a zero in the minuend.	2	3	54
14	Checks subtraction by addition.	2	3	55
15	Identifies the parts of a subtraction problem: subtrahend, minuend, difference.	2	3	49
16	Identifies addition and subtraction as inverse operations.	2	*	55, 44

III-C: Multiplies whole numbers.

01	Uses concrete objects to show that multiplication is repeated addition.	2	3	56
02	Multiplies two one-digit numbers (factors 0 to 5).	3	3	56, 57
03	Multiplies two one-digit numbers (factors 0 to 9).	3	4	56, 57
04	Multiplies a two-digit number by a one-digit number using concrete objects (no regrouping).	3	4	57

		Int	Prf	Page
05	Multiplies a two- or three-digit number by a one-digit number, with and without regrouping.	3	4	--
06	Multiplies by ten, by one hundred, and by one thousand.	4	5	57
07	Multiplies by ten thousand, by one hundred thousand, and by one million.	5	6	57
08	Multiplies a two- or three-digit number by a two-digit number, with and without regrouping.	4	5	58
09	Multiplies a three-digit number by a three-digit number (including a number with a zero in the tens place).	5	6	58
10	Multiplies a four-digit number by any number of four digits or less.	6	7	58
11	Understands the concept of one as the "identity element" in multiplication.	3	4	58
12	Identifies the parts of a multiplication problem: factor, product.	3	4	49

III-D: **Divides whole numbers.**

		Int	Prf	Page
01	Divides a one-, two-, or three-digit number by a one-digit number using concrete objects (no remainder).	3	4	59, 60-1
02	Divides a one- or two-digit number by a divisor of 5 or less (dividends 25 or less, no remainder).	3	3	57
03	Divides a one-, two-, or three-digit number by a one-digit number (with or without remainder).	3	4	60, 61, 57

		Int	Prf	Page
04	Divides a four-digit number by a one-digit number (with or without remainder).	4	5	60, 61
05	Divides a number of up to four digits by a two-digit number (with or without remainder).	5	6	62
06	Divides by a multiple of ten, a multiple of one hundred, and a multiple of one thousand	5	6	62
07	Divides a number of more than three digits by a three-digit number (with or without remainder)	6	7	62
08	Identifies the parts of a division problem divisor, dividend, quotient, remainder	3	5	49
09	Recognizes that division by zero is not possible.	4	4	62
10	Performs division in which the quotient contains zero(es).	3	5	63
11	Checks division by multiplication.	4	5	55
12	Expresses remainders as fractions.	5	6	63

III-E: **Estimates with whole numbers**.

01	Estimates the sum of two or more numbers.	3	5	64, 113
02	Estimates the difference of two numbers.	3	5	64
03	Estimates the product of two numbers.	4	6	64
04	Estimates quotients.	4	6	64, 61

		Int	Prf	Page
III-E:	**Solves problems involving whole numbers.**			
01	Solves appropriate word problems involving whole numbers, using the problem-solving process and strategies.	1	1-7	54, 59 *
02	Solves appropriate critical thinking problems involving whole numbers, using the problem-solving process and strategies.	1	1-7	65, 63, 21 **

* see also PS pages: 5, 8, 11, 13-15, 17, 19, 20, 22-27, 31-33

** see also PS pages: 5-8, 23, 11, 14,15, 17, 20, 22-27, 31-33

IV. FRACTIONS AND OPERATIONS

		Int	Prf	Page
IV-A:	**Understands fractional numbers.**			
01	Recognizes two unequal parts and identifies the larger and smaller part.	K	1	66
02	Identifies one-half of a concrete object.	K	1	66, 67
03	Identifies one-third and one-fourth of a concrete object.	1	1	66, 67
04	Identifies a fractional part (1/2, 1/3, 1/4) of a given figure or set and writes or identifies the symbol.	1	2	67, 68, 69
05	Identifies a fractional part (1/5, 1/6, 1/8, 1/10) of a given figure or set and writes or identifies the symbol.	3	4	67, 68, 69
06	Uses concrete objects to illustrate the meaning of a fraction (e.g., 3/4, 5/8).	3	4	67, 68

		Int	Prf	Page
07	Identifies and writes fractional numbers from pictorial representations (numerators greater than 1).	3	4	67, 68
08	Identifies numerator and denominator.	3	4	69
09	Identifies proper fractions, improper fractions, and mixed numbers.	4	6	69
10	Compares or orders fractions with like denominators (limit to four fractions).	4	5	70
11	Compares two fractions with unlike denominators (limit to four fractions).	5 5	6 6	70, 71, 82
12	Orders fractions with unlike denominators (limit to four fractions with denominators 2-15).	6	7	--

IV-B: **Expresses fractional equivalencies**.

01	Expresses a fraction as an equivalent fraction with a greater or smaller denominator.	5	6	72, 73
02	Expresses a mixed or whole number as an improper fraction, and expresses an improper fraction as a mixed or whole number.	5	6	74, 75
03	Expresses fractions with unlike denominators as fractions with like denominators.	5	6	--
04	Continues a consecutive equivalency pattern of fractions (e.g., 1/2, 2/4, 3/6, 4/8, . . .).	5	6	73

IV-C: **Computes with fractions**.

01	Adds two fractions or mixed numbers with like denominators (no regrouping and no simplifying).	4	5	76, 77, 78

		Int	Prf	Page
02	Adds two fractions with like denominators, expressing results in simplest terms (with or without regrouping).	5	6	76, 78
03	Adds two fractions with unlike denominators, expressing results in simplest terms (with or without regrouping).	5	6	76, 79
04	Finds the sum of whole numbers, fractions, and/or mixed numbers with like or unlike denominators, expressing results in simplest terms (with or without regrouping).	5	7	80
05	Subtracts fractions or mixed numbers with like denominators (no regrouping, no simplifying).	4	5	76, 77, 81
06	Subtracts fractions with like denominators, expressing results in simplest terms (with or without regrouping).	5	6	78
07	Subtracts fractions with unlike denominators, expressing results in simplest terms (with or without regrouping).	5	7	79
08	Subtracts mixed numbers with like or unlike denominators, expressing results in simplest terms (no regrouping).	5	7	82
09	Subtracts mixed numbers with like or unlike denominators, with regrouping, expressing results in simplest terms.	5	7	81, 82
10	Finds the difference of whole numbers, mixed numbers, or fractions with like or unlike denominators, expressing results in simplest terms (with or without regrouping).	5	7	81, 82
11	Multiplies two fractions, expressing the result in simplest terms (with or without regrouping).	5	7	82, 83

		Int	Prf	Page
12	Finds the products of whole numbers, mixed numbers, and/or fractions, expressing results in simplest terms (with or without regrouping).	5	7	83, 84
13	Divides a fraction by a proper fraction, expressing the quotient in simplest terms (with or without regrouping).	5	7	83, 84
14	Finds the quotient of whole numbers, mixed numbers, and/or fractions, expressing results in simplest terms (with or without regrouping).	5	7	85
15	Identifies the multiplicative inverse (reciprocal).	5	7	86
16	Understands the concept of removing common factors from numerator and denominator before multiplying or dividing (cancellation).	5	8	86

IV-D: **Solves problems involving fractions**.

01	Solves appropriate word problems involving fractions, using the problem-solving process and stategies.	4	5-8	82
02	Solves appropriate critical thinking problems involving fractions, using the problem-solving process and strategies.	4	5-8	84

V. DECIMAL NUMBERS AND OPERATIONS

V-A: **Understands decimal numbers**.

01	Recognizes place value in decimal numbers through hundred thousandths.	4	6	87
02	Reads and writes decimal numbers through hundredths.	4	5	87, 89

		Int	Prf	Page
03	Reads and writes decimal numbers through thousandths.	4	6	87, 89
04	Reads and writes decimal numbers ten thousandths through millionths.	5	*	87
05	Reads and writes word names for decimal numbers (e.g., three tenths, one hundredth).	4	6	88
06	Rounds decimal numbers to ones, tenths, and hundredths.	4	6	88
07	Identifies equivalent and nonequivalent decimals containing zeros (e.g., .8 = .80; .8 ≠ .08).	5	6	88
08	Compares two decimal numbers.	5	7	87, 88, 89
09	Orders decimal numbers to thousandths.	5	7	88, 89

V-B: **Expresses decimal equivalencies.**

01	Identifies decimal numbers equivalent to: 1/2, 1/4, 3/4; 1/5-4/5; 1/10 to 9/10; 1/100 to 99/100.	5	6	90, 91, 92
02	Identifies decimal numbers equivalent to: 1/3, 2/3; 1/6 to 5/6; 1/8 to 7/8.	6	7	91
03	Changes an appropriate common fraction to an equivalent terminating decimal number.	6	7	92
04	Changes an appropriate common fraction to an equivalent repeating decimal number.	6	7	92
05	Changes a terminating decimal number to an equivalent common fraction.	6	7	92, 93, 101

		Int	**Prf**	**Page**
06	Identifies decimal numbers equivalent to mixed numbers.	6	8	92, 93

V-C: Computes with decimals.

		Int	Prf	Page
01	Adds and subtracts decimal numbers through hundredths.	4	5	94, 88, 107
02	Adds and subtracts decimal numbers through thousandths.	5	6	94
03	Multiplies a whole number or decimal number by a decimal number.	5	7	94, 95
04	Multiplies a whole number or decimal number by 0.1, 0.01, 0.001, or 0.0001.	5	*	95, 96
05	Divides with decimal numbers (no more than 5-digit dividends and no more than 3-digit divisors).	6	7	96, 97

V-D: Solves problems involving decimal numbers.

		Int	Prf	Page
01	Solves appropriate word problems involving decimal numbers, using the problem-solving process and strategies.	4	5-7	113
02	Solves appropriate critical thinking problems involving decimal numbers, using the problem-solving process and strategies.	4	5-7	94

VI. PERCENT, RATIO, AND PROPORTION

VI-A: Demonstrates a working knowledge of percents.

		Int	Prf	Page
01	Identifies the percent sign.	4	5	98
02	Defines percent.	5	5	98, 99, 100
03	Changes a decimal number to a percent.	6	7	100, 101
04	Changes a percent to a decimal number.	6	7	100
05	Changes a percent to a fraction in lowest terms.	6	7	100, 101
06	Changes common fractions to percents (denominators of two, four, five, ten, twenty, twenty-five, fifty, one hundred).	6	7	99, 100, 101
07	Changes improper fractions or mixed numbers to percents.	6	8	100, 101

VI-B: Calculates rate, base, and percentage.

		Int	Prf	Page
01	Finds a percent of a given number, including percents greater than 100 (i.e., percentage).	6	7	102
02	Finds what percent one number is of another, including percents greater than 100 (i.e., rate).	6	7	102, 111
03	Finds a number when a percent of it is known, including percents greater than 100 (i.e., base).	6	7	102
04	Finds the percent of increase or decrease.	7	8	102

		Int	**Prf**	**Page**
05	Uses percentages less than one percent (including finding rate, base, and percentage).	6	8	--

VI-C: **Understands ratio and proportion**.

		Int	**Prf**	**Page**
01	Expresses a ratio of two numbers (e.g., teachers to students, number of people to number of square miles).	6	7	103
02	Defines and identifies the parts (terms) of a proportion: means and extremes.	6	7	104
03	Solves for the missing term of a proportion (e.g., 1:2 = __ :4)..	6	7	105
04	Identifies or expresses equivalent ratios.	6	8	105
05	Uses ratio and proportion in map reading.	7	7	106, 107

VI-D: **Understands consumer terms involving percents**.

		Int	**Prf**	**Page**
01	Distinguishes between simple and compound interest.	7	8	108
02	Computes simple interest.	7	8	108
03	Computes price and sale price, tax, discount, and rate of discount.	6	8	108, 102
04	Defines straight salary and commission.	6	8	108

		Int	Prf	Page
VI-E:	Solves problems involving percent, ratio, or proportion.			
01	Solves appropriate word problems involving percent, ratio, or proportion, using the problem-solving process and strategies.	6	7-8	--
02	Solves appropriate critical thinking problems involving percent, ratio, or proportion, using the problem-solving process and strategies.	6	7-8	107

VII. MEASUREMENT

		Int	Prf	Page
VII-A:	Identifies and uses measures of time.			
01	Relates concepts of time to events (e.g., now/later; morning/noon/night; yesterday/tomorrow).	K	K	109
02	Identifies the hour and minute hand on the clock.	K	1	109
03	Names the days of the week and the months of the year.	K	2	109
04	Uses the calendar to determine the day of the week, the month, and the year.	1	3	110
05	Identifies the second, minute, and hour as unit measures of time.	K	4	110
06	Tells time on the hour.	1	1	110
07	Tells time on the half hour and quarter hour.	1	2	110
08	Records time to hour and half hour, using colon notation (e.g., 12:30).	1	2	110
09	Tells time to the nearest five minutes and to the nearest minute.	3	4	110

		Int	Prf	Page
10	Records time to the nearest minute, using colon notation.	3	4	110
11	Converts seconds to minutes to hours (and conversely); hours to days to weeks (and conversely).	5	6	111

VII-B: Understands and uses measures of temperature.

01	Identifies the ° symbol as representing the unit of measure for temperature.	2	5	112
02	Identifies Celsius and Fahrenheit as the metric (SI) and customary systems for measuring temperature.	2	5	112
03	Reads a Celsius and Fahrenheit thermometer.	2	5	112
04	Relates temperature in degrees to hot, cold, or comfortable (Celsius and Fahrenheit).	2	5	112

VII-C: Understands and uses measures of monetary value.

01	Identifies a penny, nickel, dime, and quarter.	K	K	113
02	Recognizes the monetary value of a penny, nickel, dime, and quarter.	1	2	113
03	Associates the ¢ symbol with the value of a penny, nickel, dime, and quarter.	1	2	113
04	Identifies and recognizes the monetary value of a half-dollar and a dollar (coin and bill).	1	3	113
05	Finds the value of a set of coins (limit: $1.00).	1	3	113

		Int	Prf	Page
06	Given models of coins and/or bills, writes the value of money, including appropriate symbols (e.g., $2.14).	2	3	113
07	Writes numerical expressions for given money words.	3	4	113
08	Writes money words for given numerical expressions.	4	5	113
09	Performs calculations involving money.	4	5-7	113, 114
10	Converts a value in dollars and cents to an equivalent number of given coins (e.g., $1.10 = 11 dimes).	3	5	113

VII-D: Understands and uses linear measures.

01	Identifies the shorter or longer of two line segments.	K	K	115
02	Compares the position of two objects with reference to a given location (nearer/farther).	K	1	115
03	Measures length using nonstandard units of measure.	K	1	115
04	Identifies the inch and foot as units of linear measure in the customary system.	1	2	116
05	Identifies the yard and mile as units of linear measure in the customary system.	2	3	--
06	Identifies the centimeter and meter as units of linear measure in the metric (SI) system.	1	2	116
07	Measures length in half inches, inches, feet, or yards.	2	3	115, 116, 119

		Int	Prf	Page
08	Measures length in centimeters and meters.	2	3	115, 116, 119
09	Estimates and verifies the length of a given object using inches, feet, and/or yards.	2	4	116, 117
10	Estimates and verifies the length of a given object using centimeters and meters.	2	4	116, 117
11	Identifies the millimeter and kilometer as units of linear measure in the metric (SI) system.	4	5	--
12	Determines the appropriate unit of measure for a given object, to measure length in the metric (SI) and customary systems.	2	7	117
13	Converts linear measures: in metric (SI), millimeters to centimeters to meters (and conversely); kilometers to meters (and conversely); in customary, inches to feet to yards (and conversely); feet or yards to miles (and conversely).	5	6	118, 119
14	Adds or subtracts measurements of length using the customary system (inches, feet, yards).	7	8	119
15	Adds or subtracts measurements of length using the metric (SI) system (meters, centimeters).	7	8	119

VII-E: Understands and uses measures of weight (mass).

		Int	Prf	Page
01	Identifies the lighter or heavier of two concrete objects.	K	K	120
02	Identifies the ounce and pound as units of weight in the customary system.	3	4	120

		Int	**Prf**	**Page**
03	Identifies the gram, milligram, and kilogram as units of weight in the metric (SI) system.	3	4	120
04	Measures weight (mass) in grams or kilograms.	3	4	120, 121, 119
05	Measures weight in ounces and pounds.	3	4	120, 121
06	Determines the appropriate unit of measure for a given object, to measure weight (mass) in the metric (SI) and customary systems.	3	7	120, 121
07	Converts weight (mass) measures: in metric (SI), milligrams to grams to kilograms; kilograms to grams to milligrams; in customary, ounces to pounds; pounds to ounces.	5	6	118, 119
08	Adds or subtracts measurements of weight using the customary system (ounces, pounds).	7	8	121
09	Adds or subtracts measurements of weight (mass) using the metric (SI) system (kilograms, grams).	7	8	121, 119

VII-F: Understands and uses measures of capacity.

01	Identifies the smaller or larger of two containers.	K	K	122
02	Identifies the cup, pint, quart, and gallon as units of customary measure.	1	2	122
03	Identifies the liter and milliliter as units of metric (SI) measure.	2	3	--
04	Measures in cups, pints, quarts, half gallons, and gallons.	2	4	122
05	Measures liquid volume in liters.	2	4	122

		Int	Prf	Page
06	Determines the appropriate unit of measure for a given object, to measure capacity in the metric (SI) and customary systems.	3	7	122
07	Converts capacity (liquid) measures: in metric (SI), milliliters to liters; liters to milliliters; in customary, cups to pints to quarts to gallons; gallons to quarts to pints to cups.	5	6	118
08	Adds or subtracts measurements of capacity using the customary system (cups, pints, quarts, half gallons, gallons).	7	8	122
09	Adds or subtracts measurements of capacity using the metric (SI) system (liters, milliliters).	7	8	122

VII-G: Solves problems involving measurement.

		Int	Prf	Page
01	Solves appropriate word problems involving measurement, using the problem-solving process and strategies.	2	3-8	114*
02	Solves appropriate critical thinking problems involving measurement, using the problem-solving process and strategies.	2	3-8	**

* see also PS pages: 4, 5, 8, 9, 14, 24
** see PS pages: 4, 5, 8, 9, 14, 24, 28

VIII. GEOMETRY

VIII-A: Demonstrates a working knowledge of closed plane figures.

		Int	Prf	Page
01	Distinguishes between open and closed figures and between the inside and outside of a closed figure.	K	1	123, 124

		Int	Prf	Page
02	Identifies shapes: circle, triangle, square, and rectangle.	K	1	124, 125
03	Classifies objects or pictures according to shape.	K	1	125
04	Draws a facsimile of two dimensional geometric figures: circle, triangle, square, and rectangle.	1	2	125
05	Identifies parts of a circle: center, radius, diameter, circumference, semi-circle.	4	5	125
06	Identifies parts of a circle: chord and arc.	5	8	125, 126
07	Distinguishes between polygons that are regular and those that are not.	5	6	126, 137
08	Identifies types of quadrilaterals and their diagonals: square, rectangle, trapezoid, parallelogram, rhombus.	5	7	127
09	Identifies pentagon, hexagon, and octagon.	5	6	127
10	Identifies the altitude and base of a triangle and parallelogram.	6	7	127, 128
11	Classifies triangles according to sides (scalene, isosceles, equilateral).	7	8	128
12	Classifies triangles according to their angles (acute, right, obtuse).	7	8	128
13	Identifies the parts of a right triangle.	7	8	128
14	Recognizes similar and congruent figures.	5	7	129

VIII-B: Demonstrates a working knowledge of points, lines, and angles.

		Int	Prf	Page
01	Identifies lines of symmetry.	2	5	130
02	Identifies and draws representations of points, lines, line segments, and rays.	3	4	131
03	Uses grids to locate a point.	3	6	132
04	Identifies pairs of intersecting and parallel lines.	4	5	132
05	Identifies horizontal and vertical lines.	4	5	130, 132
06	Identifies perpendicular lines.	4	5	132
07	Identifies an angle, the parts of an angle, and a right angle.	4	6	131, 132, 133
08	Defines and classifies angles as acute, obtuse, right, or straight.	5	7	133, 134
09	Identifies congruent angles.	5	7	134
10	Recognizes that the sum of the measures of the interior angles of a triangle is 180°.	5	7	134, 135
11	Measures and draws angles using a protractor (up to 180°).	5	7	135
12	Constructs an angle using a straightedge and compass.	5	*	135

VIII-C: Determines perimeter and area of plane figures.

		Int	Prf	Page
01	Determines perimeter by counting the units along each side of a two-dimensional figure.	4	4	136
02	Determines the perimeter of a square, rectangle, and triangle.	4	5	126
03	Determines the perimeter of any given polygon (no conversions).	5	6	137, 126
04	Identifies the area of a square and a rectangle by counting square units enclosed.	4	4	137
05	Identifies the square inch, square foot, and square yard as units of customary measure.	4	5	137
06	Identifies cm^2 and m^2 as units of metric (SI) measure.	4	5	137
07	Determines the appropriate unit of measure for a given plane figure, to measure area in metric (SI) and customary systems.	5	6	--
08	Determines the area of a square and a rectangle (no conversions).	5	7	138
09	Determines the area of a triangle.	7	8	138
10	Uses the Pythagorean rule.	7	8	138
11	Determines the area of a parallelogram.	7	8	139
12	Determines the area of a trapezoid.	7	*	139
13	Determines the area and circumference of a circle.	7	8	139

		Int	**Prf**	**Page**
14	Recognizes and uses π in fraction (22/7) or decimal (3.14) form.	7	8	140
15	Converts area measures: in metric (SI), cm^2 to m^2; m^2 to cm^2; in customary, sq. ins. to sq. ft. to sq. yds; sq. yds. to sq. ft. to sq. ins.	6	8	140

VIII-D: Recognizes and measures spatial figures.

01	Identifies common spatial figures: cube, rectangular solid, pyramid, sphere, cone, cylinder.	2	6	141
02	Determines the volume of a cube and a rectangular solid by counting the cubic units enclosed.	5	7	142
03	Determines the volume of a cube and a rectangular solid.	5	8	142
04	Determines the volume of spatial figures: pyramids, spheres, cones, and cylinders.	7	*	142

VIII-E: Solves problems involving geometry.

01	Solves appropriate word problems involving geometry, using the problem-solving process and strategies.	4	4-8	143 *
02	Solves appropriate critical thinking problems involving geometry, using the problem-solving process and strategies.	4	4-8	143, 135, 139, 141, 142 **

* see also PS page: 18
** see also PS pages: 17, 18, 32

IX. GRAPHS, PROBABILITY, AND STATISTICS

IX-A: Constructs and interprets graphs.

		Int	**Prf**	**Page**
01	Constructs and interprets a graph using concrete objects.	K	1	144
02	Constructs and interprets a simple pictograph.	2	3	144, 145, 146
03	Interprets information presented in maps, charts, and tables.	3	3-8	145, 146
04	Constructs and interprets a simple bar graph and circle graph.	4	5	145, 146
05	Constructs, interprets, and uses data from pictographs, bar graphs, circle graphs, and line graphs.	5	7-9	146
06	Identifies the appropriate type of graph to represent given data.	6	7	146, 147

IX-B: Uses probability and statistics.

		Int	**Prf**	**Page**
01	Computes the average of not more than five numbers, each with a maximum of three digits.	5	6	148
02	Finds the mean, mode, median, and range of a set of data.	7	8	148
03	Finds the probability involved in a coin toss, the roll of a die, a turn of a spinner, or a draw of marbles or cards.	7	8	149, 150, 151
04	Interprets probability statements encountered in everyday situations.	7	8	152

IX-C: Solves problems involving graphs, probability, and statistics.

		Int	Prf	Page
01	Solves appropriate word problems involving graphs, probability, and statistics, using the problem-solving process and strategies.	3	4-8	--
02	Solves appropriate critical thinking problems involving graphs, probability, and statistics, using the problem-solving process and strategies.	3	4-8	147, 148, 150, 151 152 *

* see also PS pages: 16, 30

X. PRE-ALGEBRA

X-A: Finds squares and square roots.

01	Finds the square of a one- or two-digit number.	6	7	153
02	Identifies the square root of a number that is a perfect square (limit to numbers 1-100).	7	7	153
03	Uses a table and/or calculator to find the square root of a number.	7	7	--

X-B: Uses exponents.

01	Writes the exponential form of a power of ten given in standard form (e.g., expresses 100 as as 10^2 or 1000 as 10^3).	6	8	154
02	Writes the standard form of a number given in exponential form, including zero as an exponent (e.g., expresses 6^3 as 216).	7	8	154

		Int	**Prf**	**Page**
03	Expresses numbers in scientific notation (e.g., expresses 6000 as 6×10^3).	6	8	154
04	Interprets numbers given in scientific notation (e.g., reads 6×10^3 as 6000).	6	8	154

X-C: **Identifies and uses integers and rational numbers.**

01	Defines and identifies integers.	6	7	155, 156
02	Classifies integers as positive, negative, or zero.	6	7	155, 156
03	Locates integers as points on a number line.	6	7	155, 156
04	Orders three or more integers (positive and negative).	6	7	157
05	Identifies opposites (additive inverse) as a pair of integers whose sum is 0 (e.g., 8 and -8).	7	9	155, 156
06	Understands the concept of absolute value.	7	9	156
07	Adds, subtracts, multiplies, and divides integers.	7	9	157, 158, 159
08	Adds, subtracts, multiplies, and divides rational numbers (positive and negative).	7	9	158, 159
09	Locates rational numbers as points on a number line.	7	9	156
10	Identifies rectangular coordinate system, ordered pair, horizontal and vertical axes, origin, quadrants, abscissa and ordinate, graph of a linear equation.	8	9	--

		Int	**Prf**	**Page**
11	Locates and relates points in a plane to ordered pairs of numbers.	8	9	--
12	Graphs linear equations in two variables.	8	9	--

X-D: Operates on real numbers.

		Int	Prf	Page
01	Performs multiple operations on real numbers, with and without grouping symbols.	8	9	--
02	Adds real numbers, using a number line or the rules for adding real numbers.	8	9	--
03	Subtracts real numbers, using the definition of subtraction.	8	9	--
04	Multiplies real numbers.	8	9	--
05	Divides real numbers.	8	9	--
06	Recognizes and uses the axioms of real numbers.	8	9	--
07	Recognizes irrational numbers.	8	9	--

XI. ALGEBRA I

XI-A: Understands the language of mathematics.

		Int	Prf	Page
01	Identifies mathematical symbols: ≥ , ≤ , ( ), [ ], { }, | |, etc.	9	10	--
02	Defines and identifies real numbers and subsets of real numbers.	9	10	--
03	Constructs a number line and graphs subsets of real numbers.	9	10	--

		Int	**Prf**	**Page**
04	Compares any two real numbers.	9	10	--
05	Defines and determines the absolute value of a real number.	9	10	--
XI-B:	**Understands and uses the language of algebra**.			
01	Defines a constant, variable, base, exponent, coefficient, factor, term, and an algebraic expression.	9	10	--
02	Evaluates algebraic expressions given a replacement set for the variable(s).	9	10	--
03	Defines and identifies an equation, open sentence, replacement set, root, solution set, member of an equation, and linear equation.	9	10	--
04	Uses the axioms of equality: reflexive, symmetric, and transitive.	9	10	--
05	Uses the properties of equality to solve linear equations in one variable.	9	10	--
06	Defines and identifies a linear inequality.	9	10	--
07	Uses properties of inequalities to solve and graph the solution set of linear inequalities.	9	10	--
08	Solves and graphs the solution set of compound sentences that involve linear inequalities (no absolute value).	9	10	--

XI-C: Solves and uses first degree equations and inequalities (one variable).

		Int	Prf	Page
01	Solves linear equations containing variables in both members of the equation.	9	10	--
02	Solves inequalities that contain variables in both members of the inequality.	9	10	--
03	Translates verbal expressions to algebraic expressions and vice versa.	9	10	--
04	Uses linear equations to solve word problems involving number relations (e.g., number, consecutive integer, geometry, distance, coin, and age problems).	9	10	--

XI-D: Understands and operates on polynomials.

01	Defines monomial, binomial, trinomial, polynomial, degree of a polynomial, and coefficient.	9	10	--
02	Writes the terms of a polynomial in descending or ascending order.	9	10	--
03	Adds polynomials by combining similar terms.	9	10	--
04	Subtracts polynomials by using the definition of subtraction and combining similar terms.	9	10	--
05	Uses the laws of exponents to multiply two or more monomials, a polynomial by a monomial, or two polynomials.	9	10	--
06	Uses the laws of exponents to divide two monomials, a polynomial by a monomial, or two polynomials.	9	10	--

		Int	Prf	Page
07	Uses the laws of exponents to write equivalent expressions for monomials with zero and negative exponents (answers with positive exponents).	9	10	--

XI-E: Factors polynomials.

		Int	Prf	Page
01	Defines and finds the prime factors of two or more integers.	9	10	--
02	Finds the greatest common factor of two or more algebraic expressions (integers and monomials).	9	10	--
03	Factors special types of polynomials (e.g., difference of two squares, trinomial squares, quadratic trinomials).	9	10	--

XI-F: Performs operations with fractional expressions and solves fractional equations.

		Int	Prf	Page
01	Defines and determines the restricted value of an algebraic fraction.	9	10	--
02	Reduces algebraic fractions.	9	10	--
03	Finds the product of two or more algebraic fractions.	9	10	--
04	Finds the quotient of two or more algebraic fractions.	9	10	--
05	Finds the least common multiple of two or more algebraic fractions.	9	10	--
06	Combines algebraic fractions by addition and subtraction.	9	10	--

		Int	**Prf**	**Page**
07	Simplifies mixed expressions by adding a polynomial and a fraction.	9	10	--
08	Solves first degree fractional equations.	9	10	--

XI-G: Solves and uses linear equations and inequalities (two variables).

01	Identifies graph of an inequality, x and y intercepts, slope of a line, system of equations.	9	10	--
02	Graphs linear inequalities in two variables.	9	10	--
03	Finds the slope of a line, given either a graph of the line, or the coordinates of two points of the line, or an equation of the line.	9	10	--
04	Writes linear equations in slope-intercept form or point-slope form.	9	10	--
05	Solves systems of linear equations, by graphing, by the addition and subtraction method, and by the substitution method.	9	10	--

XI-H: Performs operations on radical expressions and solves quadratic equations.

01	Defines or identifies: terminating decimal, repeating decimal, rational number, irrational number, principal square root.	9	10	--
02	Finds the square of a variable.	9	10	--
03	Finds the square root of a variable that is a perfect square and simplifies monomial square roots.	9	10	--

		Int	Prf	Page
04	Identifies and uses the multiplication and division properties of radicals.	9	10	--
05	Simplifies radical expressions.	9	10	--
06	Performs operations on radicals, including multiplication and division, addition and subtraction, and rationalizing denominators.	9	10	--
07	Solves quadratic equations by factoring and by using the quadratic formula.	9	10	--
08	Solves verbal problems whose solutions involve quadratic equations.	9	10	--

PROBLEM-SOLVING PROCESS AND STRATEGIES

PROBLEM-SOLVING PROCESS AND STRATEGIES
Introduction

The world that children will live in as adults will require that they acquire the skills to solve problems and to ask good questions. Mathematics should be taught so that mathematical concepts and skills make sense to the student. The emphasis on problems must come first; it is the starting place for developing arithmetic understanding and for establishing the need for computation. The student needs to see that developing computational skills serves a purpose--that computational skills are tools for solving problems.

The problem-solving process. The problem-solving process for mathematics has been described in a variety of ways, but at least four steps are identified in most models. These are:

1. Reading or understanding the problem
   --the student decides what s/he is trying to find and what information is needed or irrelevant.
2. Devising a plan
   --the student decides what problem-solving strategies are appropriate to use for the problem.
3. Carrying out the plan
   --the student uses selected strategies to compute the answer or solve the problem.
4. Checking the answer
   --the student reviews his/her answer to make sure that it is reasonable and verifies its accuracy.

It is clear from this description of the problem-solving process that mathematics instruction should be directed at teaching students "how to think." Students should be exposed when they are very young to problems that require thinking beyond rote response. To be effective in helping students to develop and sharpen their problem-solving skills, teachers should avoid illustrating all of the steps in the solution of numerical exercises. Instead, teachers should present relevant problems and guide students toward solutions rather than tell them the answers.

Asking good questions, for example, helps students go forward toward solutions. Allowing sufficient time for students to solve problems is also important; during this "wait time," the teacher does not talk, but allows students the opportunity to think or talk to one another. In general, students' exploration and discovery of solutions is more useful than passive reception of the answers in learning how to solve problems independently.

Problem-solving strategies. Research has shown that the teaching of specific problem-solving strategies greatly improves students' problem-solving abilities and results in dramatic increases in their scores on related tests. Strategies are not specific to particular problems or to particluar areas of the mathematics curriculum, but can be applied alone or in combination with other strategies to solve a wide variety of problems. Gaining familiarity with different strategies, seeing them modeled, and then trying to apply them can provide students with useful tools for tackling problems.

Although the list may not be comprehensive, the thirteen problem-solving strategies identified below constitute a good repertoire of strategies that can serve as a basis for solving problems in school and in life.

1. Uses common word problem strategies to solve problems.
2. Breaks problems into parts to solve two-step or multi-step problems.
3. Uses trial and error to solve problems (guess and check).
4. Uses dramatization to solve problems.
5. Uses concrete objects to solve problems.
6. Draws pictures or diagrams to solve problems.
7. Given relevant information, works backwards to solve problems.
8. Looks for patterns to solve problems.
9. Constructs and uses tables, lists, and charts to solve problems.
10. Solves a similar or simpler problem to help find a solution.
11. Constructs and interprets graphs to solve problems.
12. Writes simple equations to solve problems.
13. Uses logical reasoning to solve problems.

Examples of exercises designed to teach each of these thirteen strategies complete this section.

Suggestions for teaching problem solving. Presented below are a set of general suggestions for teaching problem solving.

1. Provide a wholesome emotional climate for problem solving.
2. Teach various problem-solving strategies.
3. Emphasize the method of solution rather than the solution.
4. Encourage experimentation, trial and error, estimation, intuition, guessing and hunches to suggest a method of solution.
5. Expose students to many problems and to varied problems so that they develop flexibility in problem-solving behavior.
6. Provide sufficient time for discussion, practice, and reflection on problems and problem-solving strategies.
7. Have students construct their own problems.
8. Attempt to find the source of the students' difficulty and use various instructional techniques to remove these difficulties.
9. Insist on persistent effort and on concentrated and sustained attention.
10. Provide very frequent short sets of problems on which the students experience absolute success.
11. Promote problem solving through the use of mathematical games and other activities.
12. Have students work together in small groups.
13. Attempt to establish and maintain students' motivation.
14. Show the learner how to ask him/herself questions.
15. Give conscious attention to reading skills.
16. Use problem situations to discover new mathematical concepts, principles, or relationships.
17. Use problem situations as a basis for practice and as a substitute for isolated drill exercises.
18. Model good problem-solving behavior.

PROBLEM-SOLVING STRATEGIES

1. Uses common word problem strategies.

Some strategies are used at all grade levels. These common strategies require the least effort on the part of the students, but they are the strategies used most often in solving word problems. Solving word problems in textbooks is only a small part of learning how to be a good problem solver.

The four strategies most often used in solving word problems are:

A. Write or ask a question.
B. What is missing?
C. What is the operation?
D. Write a problem.

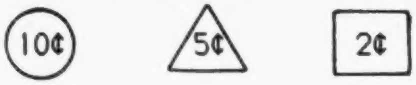
A. WRITE OR ASK A QUESTION

The question is very important in solving word problems. To emphasize the importance of the question, students should practice writing or asking questions.

VII-G: 01, 02

1. Facts using money can be used by primary students to ask questions.

Given:



Use the facts about the cost of the shapes to ask some questions.
(Wait and elicit responses.)

Examples:
a. How much more does a circle cost than a triangle?
b. What is the cost of both a circle and a square?

VII-G: 01, 02; III-F: 01, 02

2. Facts can also be shown in an advertising format.

Given:

Bananas	Grapefruit	Potatoes
3 lbs. for 85¢	3 for $1.00 40¢ each	5 lbs. for $1.50 or 35¢ a lb.

Use the information in the ads to ask or write questions. (Wait and elicit responses.)

Examples:
- a. How much is saved if you buy one 5 lb. bag of potatoes instead of five 1 lb. bags?
- b. How much do two grapefruit cost?
- c. How much do six pounds of bananas cost?

B. WHAT IS MISSING?

VII-G: 02

1. Sometimes problems do not have enough information to be solved. Students need to tell which fact is missing.

   a. Given: Bob weighs 62 kilograms. How much heavier is Bob than Mike?

      Missing Fact: Mike's weight (allow time for students to respond)

   b. Given: Joe made $52 painting fences. How much did he earn for each hour he worked?

      Missing Fact: The number of hours Joe worked (allow time)

C. WHAT IS THE OPERATION?

After reading a problem, students need to decide whether to add, subtract, multiply, or divide. There are four general rules that can help students make a decision.

- When you combine two or more things, you add.
- When you find the difference between numbers or amounts or which is larger or taller, you subtract.
- When you repeat one number several times, you multiply.
- When you separate something into groups of the same amount, you divide.

III-F: 02

1. To practice picking out the operation, often the best activity is to circle the correct symbol needed to solve the problem. It is not necessary to do the computation.

   a. Given: Mike is 62 inches tall, and Sam is 58 inches tall. How much taller is Mike than Sam?

   + – x ÷

   b. Given: A camping trip for five boys cost $70.45. How much did each boy pay?

   + – x ÷

   c. Given: Sue baked 142 cookies. Mary baked 86 cookies. Ann baked 108 cookies. How many cookies did they bake in all?

   + – x ÷

   d. Given: There are eight cans in a carton. How many cans are there in nine cartons?

   + – x ÷

D. WRITE A PROBLEM

Students need the experience of writing problems, to think of a question and the facts to make up the problem. Teachers can give an answer and then have the students write the problem. Sometimes students are amazed at how many different problems can have the same answer.

III-F: 02

1. Ask students to write a word problem using this information (may be done orally with young students).

   Example: If Mary and the lamb weigh 75 pounds, and Mary weighs 50 pounds, how much does the lamb weigh?

Problem: ______________________________

____

VII-G: 01, 02; III-F: 02, 01

2. Ask students to think of a question and the facts to make a problem. Allow time and discuss orally.

   a. Given: The answer is $7.50.

      Example Problem: I have $10. I buy a book for $2.50. How much change do I receive?

   b. Given: The answer is 6 robots.

      Example Problem: Ruth has 24 robots. Tom has 18 robots. How many more robots does Ruth have than Tom?

   c. Given: The answer is 300 miles.

      Example Problem: The Smith family traveled 85 miles on Monday, 150 miles on Tuesday, and 65 miles on Wednesday. How many miles did the family travel in three days?

PROBLEM-SOLVING STRATEGIES

2. Breaks into parts to solve two-step or multi-step problems.

In problem solving students have much more trouble with two-step and multi-step problems than with one-step problems. In a multi-step problem, the solver is required to obtain some preliminary information from the problem itself before proceeding on to the final answer.

Multi-step problems present greater difficulty for students because they require students to identify and use an "in-between" step and because most of their problem-solving experiences have been with one-step problems.

VII-G: 01, 02

1. Ask students to find some hidden questions.

   a. "Mike bought a hamburger for $1.79 and a soft drink for 79¢, tax included. How much change did he receive from a $5 bill?" What is the hidden question? (What is the cost of the hamburger and the drink? ($2.58) What is the final answer? ($2.42)

   b. "Linda bought four record albums at $6.49 each. She paid $1.82 in sales tax. How much did she spend altogether?" What is the hidden question? How much did the four records cost before the tax was added? ($25.96) What is the final answer? ($27.78)

PROBLEM-SOLVING STATEGIES

3. Uses trial and error to solve problems (guess and check).

Probably the most commonly used strategy in our everyday lives is guess and test or check. This strategy involves guessing at an answer and testing or checking to see if the guess works. Guess and test is a reliable method in most areas of mathematics and science. Hypotheses (the guess) are made and then verified by testing them (the test) in order to draw a conclusion. But this strategy is contrary to traditional teaching in which guessing is not encouraged.

In order to discourage blind or wild guessing, students need to learn how to make an educated guess, test the guess, and if the guess is not correct, use that information to make another guess. Students need to learn that finding a solution may take several guesses, but that it's important to continue until a solution is found.

A prerequisite to making an educated guess is estimation. Students should be given many opportunities to estimate and then to check for accuracy. Have students estimate a measurement of any kind then check to see what the correct answer is How many inches tall is that person? How many meters is it between those two telephone poles? How many pounds does that book weigh? How many more pounds do you think the dictionary weighs? By providing opportunities for students to guess and check, you are providing a frame of reference from which they can make educated guesses.

The example which follows shows that using the first and second guesses is helpful in finding the solution by the third try. Stress the point that guessing is one way to find a solution, and that one needs to learn to use the guess to help solve problems.

III-F: 01, 02

1. Sum of Consecutive Numbers: The sum of three consecutive numbers is 45. What are the numbers?

1st Guess: ______ + ______ + ______ Test: ______

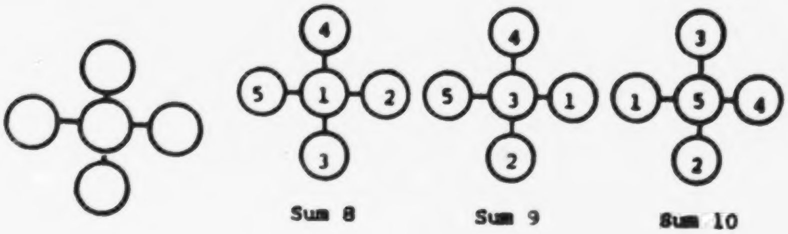
2nd Guess: ______ + ______ + ______ Test: ______

3rd Guess: ______ + ______ + ______ Test: ______

(14 + 15 + 16 = 45)

III-F: 01, 02

2. Number of Puzzles: Use the numbers 1, 2, 3, 4, and 5 to make the sum of eight in both directions on the following puzzle.



This activity can also be done using discs with the number 1, 2, 3, 4, and 5 written on them. The student can move the discs around until the sum of 8 is in both directions. Have the student make a record of his/her results. After s/he finds the sum of 8, have him/her find the sums of 9 and 10.

III-F: 01, 02

3. Computation Puzzle: Find as many ways as you can to make this true using the numbers 1-9.

☐☐☐
+ ☐☐☐
☐☐☐

The discs from the number puzzle activity could also be used for this activity. Have students record their results. (There are 320 possible solutions. Digits in sum will equal 18.)

PROBLEM-SOLVING STRATEGIES

4. Uses dramatization to solve problems (acts out).

Some problems lend themselves to experimentation or "acting out." Students can sometimes solve a problem best by "doing it." Acting out problems will force the student to understand the nature of the problem. In most cases if a student can act out a problem, we can feel sure that s/he understands the problem. For example, if a student is asked to determine the length of the longest side of a rectangular table, the answer can be found by placing a pencil end-over-end along the table.

Another example would be to determine how many times you can pat your foot in 30 seconds. Again, this can be acted out to find the answer.

Word problems or story problems also lend themselves to the problem-solving strategy of "acting out." Many word problems are provided in the mathematics textbooks. However, students should be given a lot of opportunities to act out stories before working with textbook word problems. At first, emphasis should be placed on making sense of the situation and then applying the appropriate arithmetic. Mary Baratta-Lorton has included in her book Mathematics Their Way some very good activities for young students. A number of these activities can be acted out.

III-F: 01

1. Put Pepperidge Farm Goldfish crackers in a cup for each student. Tell students to put the cup in front of them. Read the following story.

THE OCTOPUS STORY

This is a story about an octopus. He was a big octopus and he liked to eat little fish. In this story you are going to pretend that you are the octopus.

This is the ocean. *(The teacher holds out his/her hand.)*

Who is the octopus?
Let me see your ocean.

One beautiful, sunny day the octopus was swimming in the deep, blue ocean. Suddenly he saw three fish swim by. Show me three fish. He thought, "I'm hungry; I believe I'll eat two fish for my morning snack." So he did. Show me what happened. How many fish are left in your ocean. (1)

A little later five more fish swam by. How many fish in your ocean now? Mr. Octopus thought, "It's getting close to lunch time. I will eat four fish for lunch." So he did. How many fish do you have left? (2)

III-F: 01, 02; VII-G: 01, 02

2. Present the following problem to students:

DEALING IN HORSES

A man bought a horse for $50 and sold it for $60. He then bought the horse back for $70 and sold it again for $80. What do you think was the financial outcome of these transactions?

___ Lost $20
___ Lost $10
___ Came out even
___ Other (describe) ______________________________
___ Earned $10
___ Earned $20
___ Earned $30

Explain your reasoning: ______________________________
____

Assign students to groups according to the answer they chose. For example, everyone who chose the answer "earned $10" should be in one group; everyone who answered "lost $10" should be in a group, etc.

Ask for volunteers to help act out the problem. You will need three volunteers. One to be the owner, one to be the buyer, and one to be the horse. You will also need play money ($20 bills and $10 bills).

Solution: Earned $20.

III-F: 01, 02; VII-G: 01, 02

3. Place 20 pennies on the table in a row. Replace every fourth coin with a nickel. Now replace every third coin with a dime. Now replace every sixth coin with a quarter. What is the value of the 20 coins now on the table?

Solution: $1.35.

PROBLEM-SOLVING STRATEGIES
5. Uses concrete objects to solve problems.

Using objects is another problem-solving strategy. One way teachers give students experience using this strategy is to tell stories and have students act them out by using objects to represent cars, cookies, children, etc.

III-F: 01

1. Present the following problem to students, asking students to use Unifix cubes or other concrete objects to do the activity.

    > There were four horses in the pasture. Show me four horses by using the cubes. Two more horses wandered into the pasture. How many horses were there altogether?

III-F: 01, 02

2. Present: THE STACKS PROBLEM

    Show the ways that 15 Unifix cubes can be put into four stacks so that each stack has a different number of cubes and there is at least one cube in each stack. Suppose you tried this, putting the 15 cubes into three stacks instead. Would there be more ways or fewer ways and how many?

3. Play: HOW MANY ROLLS TO GET A 1?

Roll one die until a one comes up. Record how many rolls it took. Do this five times. Put your five results on the class chart.

Before getting started, here are some ideas for discussion questions: Is it possible to get a 1 on your first roll? Do you think it's possible to roll 100 times and still not get a 1? Is that likely? What do you feel is likely? What do you think the results will look like?

A group chart can be made like this. Students can enter their results with tallies. Discuss the results when all have entered their data.

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
or more

Suppose the question was: How many rolls would you need to get a 6? Would the results be similar or different? How could you find out?

PROBLEM-SOLVING STRATEGIES
6. Draws pictures and diagrams to solve problems.

Another strategy students can use to help solve problems is to draw a picture. Everyday you draw pictures to help solve problems that are encountered. Many mathematics problems can be solved by drawing pictures.

III-F: 01, 02

1. Assign the following problem:

> Jim is in line at the bridge waiting to pay his toll. He counts four cars in front of him and six cars behind him. How many cars are in line at the bridge?

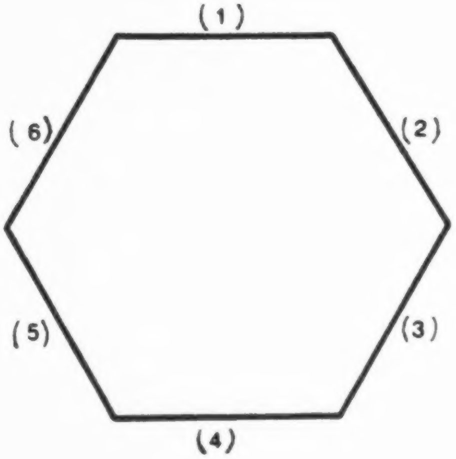
Solution: x x x x x x X x x x x = 11

________ (Jim) _____

VIII-E: 02

2. Assign the following problem:

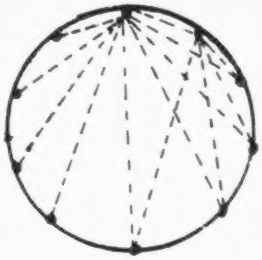
> The six students in Mr. Smith's biology class were arranged numerically around a hexagonal table. Which student was opposite number 4?



VIII-E: 02, 01

3 Assign the following problem:

Suppose you put 10 dots on a circle. If you drew lines connecting every dot to all other dots, how many lines would you draw?



Solution: 45 lines

PROBLEM-SOLVING STRATEGIES
7. Working backwards to solve problems.

Another strategy we often use when the outcome of a situation is known but the initial conditions are unknown is working backwards. When working backwards, we reverse the original operations. That is, subtraction will replace addition and division will replace multiplication.

III-F: 01

1. Tell students that if they multiply a given number by 4 and add 3 the answer will be 31. Ask: What is the given number?

   Explanation: To find the number, each operation is reversed, starting with the last operation and moving up to the first operation. Instead of adding 3, subtract 3. Instead of multiplying by 4, divide by 4.
   (31 - 3 = 28 ÷ 4 = 7)

?

x 4 = ?
+ 3 = ?

Answer: 31

Solution

7

÷ 4 = 7
- 3 = 28

31

III-F: 01

2. Tell students that if they add a given number to 5, then multiply by 2, then subtract 1, the answer will 21. Ask: What is the given number?
   (21 + 1 = 22 ÷ 2 = 11 - 5 = 6)

?

+ 5 = ?
x 2 = ?
- 1 = 21

Answer: 21

Solution

6

- 5 = 6
÷ 2 = 11
+ 1 = 22

Answer: 21

III-F: 01, 02

3. Present the following problem:

> Jimmy was trying a number trick on Sandy. He told her to pick a number, add 5 to it, multiply the sum by 3, then subtract 10 and double the result. Sandy's final anwer was 28. What number did she start with?

Solution: We began with Sandy's answer, 28. Since she doubled the result, divide by 2 to get 14. She subtracted 10, so we add 10 (to get 24). Divide by 3 to get 8, then subtract 5. Her starting number was 3.

PROBLEM-SOLVING STRATEGIES

8. Looks for patterns to solve problems.

Patterns and relationships are very important to students' understanding of mathematics. Students should be encouraged to think, seek, and discover patterns for themselves.

Patterns are plentiful. Mary Baratta-Lorton offers an explanation of the importance of the study of patterns.

> "Looking for patterns trains the mind to search out and discover the similarities that bind seemingly unrelated information together in a whole . . . A child who expects things to make sense looks for the sense in things and from this sense develops understanding. A child who does not see patterns often does not expect things to make sense and sees all events as discrete, separate, and unrelated."

There are several things to remember about patterns.

a. Patterns are the basis of how our number system is structured.

b. Students think of mathematics as a set of rules and steps to follow, to which getting the right answer is the goal. They do not try to look for the underlying order and logic of mathematics.

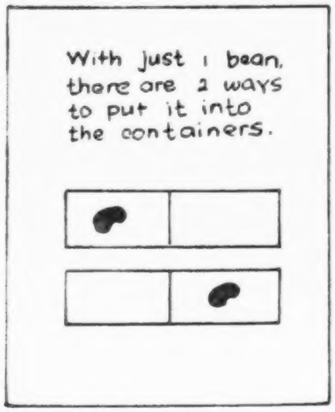
c. If students do not learn to use patterns as a basic approach to understanding, learning is much more difficult than it should be.

d. Patterns make it possible to predict what is supposed to happen in mathematics, rather than seeing the teacher's answer book as the only source for verification of thinking.

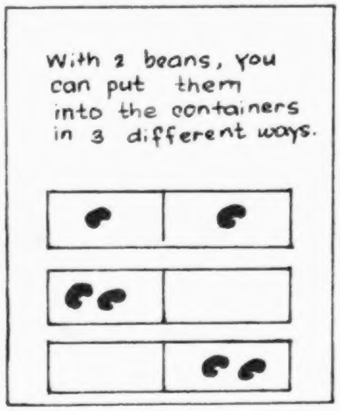
III-F: 01, 02

1. Present: Beans and Ways

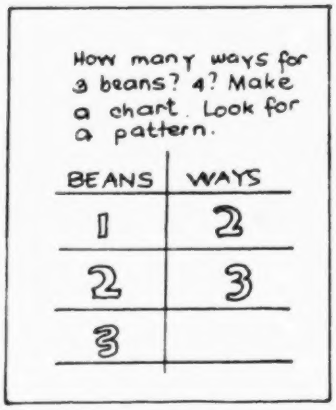
Suppose you had 25 beans (or pennies or other counters) and 2 containers (small cups or squares drawn on paper). How many ways could you put the 25 beans into the containers?



With just 1 bean, there are 2 ways to put it into the containers.



With 2 beans, you can put them into the containers in 3 different ways.



How many ways for 3 beans? 4? Make a chart. Look for a pattern.

BEANS	WAYS
1	2
2	3
3	

III-F: 01, 02

2. Ask students to: Find the Rule. Complete the series.

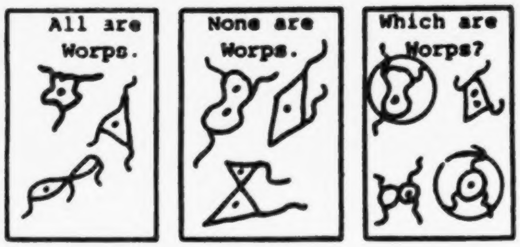
a. Given: 3, 6, 12, 24, $\boxed{48}$, $\boxed{96}$
Rule : Multiply by 2

b. Given: 6, 10, 7, 11, 8, $\boxed{12}$, $\boxed{9}$
Rule : Add 4, subtract 3

c. Given: 2, 2, 4, 6, 10, 16, $\boxed{26}$, $\boxed{42}$
Rule : Add two consecutive numbers.

III-F: 02

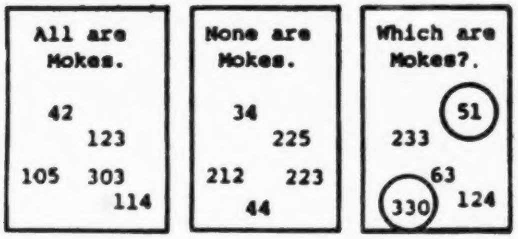
3. Ask students to: Find the common property. Circle the answers.



Solution: Worps have 1 dot and 3 tails. The students need to find the common properties.

III-F: 01, 02

4. Present the following to students and ask them to discover which numbers are "mokes."



Solution: Mokes are numbers whose digits add to 6.

PROBLEM-SOLVING STRATEGIES
9. Constructs tables, charts, or lists to solve problems.

Putting information in a table, chart, or list is an excellent way to organize data. Once information is organized in this way, solutions to problems can be more easily found.

III-F: 01, 02; VII-G: 01, 02

1. Present the following charts and exercises to students:

   a. You have dimes, nickels, and pennies. How many ways can you make 10¢ using dimes, nickels, and pennies?

10¢	5¢	1¢
1	0	0
0	2	0
0	1	5
0	0	10

   b. You have quarters, dimes, nickels, and pennies. How many ways can you make 25¢?

25¢	10¢	5¢	1¢
1	0	0	0
0	2	1	0
0	2	0	5
⋮	⋮	⋮	⋮
0	0	0	25

III-F: 01, 02

2. Present the following problem:

> There are the same number of bicycles and wagons. There are 30 wheels altogether. How many of each are there?

Bicycles	Wagons	Total Wheels
1	1	6
3	3	18
4	4	24
5	5	30

By entering the information in a table, the solution of 5 bicycles and 5 wagons is easily found.

III-F: 01, 02

3. Present the following problem:

> Ms. Jones gave a math test of twenty questions. She gave two points for each correct answer and subtracted three points for each wrong answer. Roger answered all twenty questions and got a grade of zero. How many questions did Roger answer wrong? (Use the table below.)

A * Correct	B * Wrong	C Col. A x 2	D Col. B x 3	E Col. C - Col. D

PROBLEM-SOLVING STRATEGIES
10. Solves a similar/simpler problem.

Realistic problems often contain very large numbers. These tend to obscure the procedures and processes needed for solving the problem. The problem can be simplified or reduced but remains mathematically unaltered if smaller numbers are substituted or number of cases reduced. The solution of a simpler problem will aid the student in seeing patterns and provide insight toward the solution of the more complex original problem.

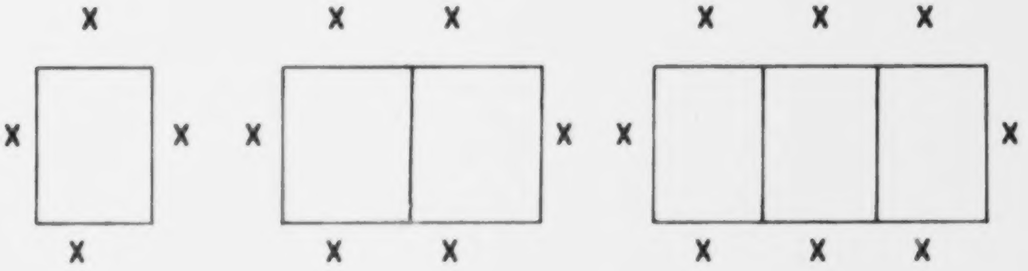
III-F 01, 02

1. Present this problem:

   Twelve couples have been invited to a party. The couples will be seated at a series of small square card tables, placed end to end so as to form one large long table. How many of these small tables are needed to seat all 24 people?

   (Steps to solution)

   Students should draw a picture of what the situation looks like for 1 table, for 2 tables, for 3 tables, etc. Then record the data on a chart.



Number of tables	1	2	3	4		n
Number of guests	4	6	8	10		24

Continued . . .

Suppose we limit the number of guests to a smaller number, say 16. Let's see if our pattern holds true. Extend the chart.

Number of tables	1	2	3	4	5	6	7
Number of guests	4	6	8	10	12	14	16

Since the pattern seems to be holding true for 16 guests, we can continue to add 1 table for every 2 additional guests until we reach our required number of 24 guests. We thus add 4 additional tables for the additional guests (16 + 8 = 24). It will take 11 tables to accommodate 24 guests.

III-F: 01, 02

2. Present this problem:

> A Polaris Commuter has seats for 108 passengers. On a flight to Memphis, there was 1 empty seat for every 2 passengers actually on board. How many passengers were on the flight?

(Steps to solution)

A simpler problem would be one that considered a plane with seats for 12 passengers.

E	X	X
E	X	X
E	X	X
E	X	X

Empty	People	Total
1	2	3
2	4	6
3	6	9
4	8	12

The pattern revealed by the table leads to $x + 2x = 108$

$3x = 108$ $\qquad$ $x = 36$ $\qquad$ $36 + (72) = 108$

3. Present the following problem

> Of 200 coins, 199 are the same weight and one is lighter than the others. Given a balance with two pans for comparing weights, what is the least number of weighings needed to determine which coin is light?

(Solution to simpler problem)
To simplify the problem, reduce the number of coins to seven; six are the same weight and one is lighter than the others. Given the same balance, explain how the light coin may be identified in no more than two weighings.

Weigh six of the coins--3 and 3. If they balance, the lighter coin is the one of the seven not weighed. Otherwise, weigh two of the three coins from the lighter side of the balance. Once again, if it balances, the lighter coin was the one of the three not weighed. If it doesn't balance, the lighter coin is easily identified.

PROBLEM-SOLVING STRATEGIES

11. Constructs and interprets graphs to solve problems.

Graphing is a way to present data in a clear, concise, and visual way that makes it possible to see relationships more easily. In order to learn to interpret graphs and use them as a problem-solving strategy, students benefit by first making their own. Making graphs requires collecting and then sorting and classifying data. Experiences can be provided at all grade levels.

For younger students, graphing experiences should begin concretely. The possibilities for things to graph are best taken from the interests of the students and experiences that occur in the classroom. After students become more familiar with graphs, they should be able to tell you information without being prompted with questions.

There are three levels of graphs, from the concrete to the abstract. They are Concrete Graphs, Picture Graphs, and Symbolic Graphs.

Concrete Graphs use actual objects to compare, and they build on students' understanding of more and less. Starting with real graphs is essential for young students and is useful as well to help older students see that abstract information can be related to the real world. The simplest of real graphs sorts objects into two groups. (Example: shoes with laces and shoes without laces.)

Picture Graphs use pictures of models to stand for real things. Students can draw pictures to represent the actual object or cut pictures from magazines.

Symbolic Graphs are most abstract because they use symbols to represent real things. Graphs in which you make a tally mark or color in a square are examples of symbolic graphs.

1. Divide students into groups of four and ask each group to construct a graph using newsprint and markers. The graphs should be designed to find out information about the students.

Examples:
- a. How old are you?
- b. What is your favorite color?
- c. What make of car does your family drive?
- d. Is your hair straight, wavy, or curly?
- e. What is your favorite breakfast drink?

As each group completes its graph, post the graphs so that they may be marked by all participants. Discuss each graph and ask for questions that can be formulated from each graph.

Examples of other topics for graphs follow:

- a. Where you were born (state or country)
- b. Position of birth in your family
- c. Your dominant hand
- d. Month of your birthday
- e. Number of hours you usually sleep each night
- f. How you sleep: side, back, or stomach
- g. How many close friends you have
- h. Year of car your family drives
- i. How many radios in your house
- j. How many TVs in your house
- k. Number of smokers in your family
- l. Favorite ice cream flavor
- m. Seat belt use: always, usually, occasionally, or never
- n. What do you want to be when you grow up?

PROBLEM-SOLVING STRATEGIES

12. Writes simple equations to solve problems.

Writing an equation is a strategy often used in mathematics to solve problems. Early experiences with this strategy should be those which will guide students to translate from English to mathematical terms. An example of this would be to express the following statement as a mathematical equation: Mary is four years older than John ($M = J + 4$). The true test of math understanding is the ability to translate from real-life situations to math symbols and from math symbols to real-life situations. The emphasis should continue to be placed on the importance of understanding in working problems and not merely on getting right answers.

III-F: 01

1. Present this problem:

A certain number added to itself 3 times is the same as 2 times 9.

$$\square + \square + \square = 2 \times 9$$

III-F: 01, 02

2. Present this problem:

Three students the same age added their ages and found the sum to be 2 more than the age of the principal who was 34. How old was each student?

$$\square + \square + \square = 34 + 2 \quad \underline{\text{or}} \quad 3 \times \square = 34 + 2$$

III-F: 01, 02; VIII-E: 02

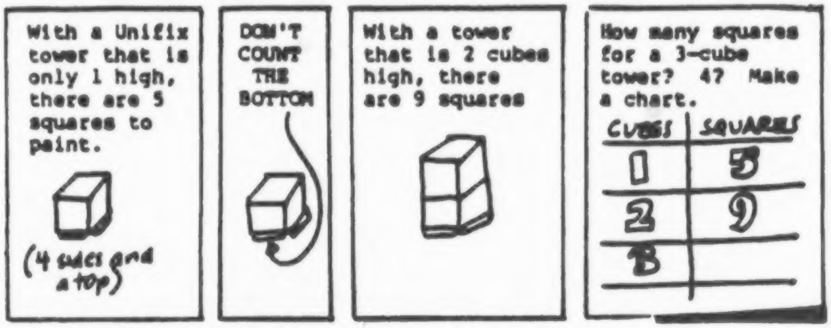
3. Ask students to find at least one rectangle where the number of square inches of area is the same as the number of inches in the perimeter.

$$L \times W = 2(L + W)$$

III-F: 01, 02

4. Present this problem:

Suppose you build a Unifix tower that is 99 cubes high. And suppose you had to paint each square on the tower. How many squares would you have to paint?


With a Unifix tower that is only 1 high, there are 5 squares to paint.
(4 sides and a top)
DON'T COUNT THE BOTTOM
With a tower that is 2 cubes high, there are 9 squares
How many squares for a 3-cube tower? 4? Make a chart.
CUBES | SQUARES
1 | 5
2 | 9
3 |

Solution: Let "n" represent the number of cubes. Each cube has four sides, so n x 4 would represent the number of side squares to be painted. But each time a cube is added there will also be one top square to paint; therefore, the equation (n x 4) + 1 will help us solve the larger problem.

$(n \times 4) + 1$

$(99 \times 4) + 1 = 397$ squares

III-F: 01, 02

5. Present the following problem:

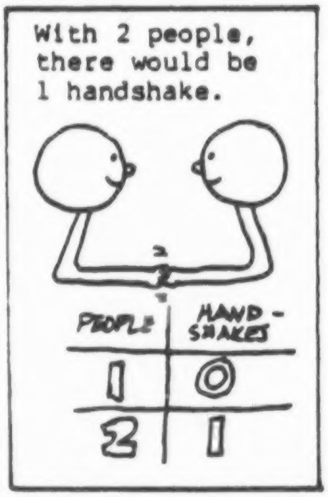
> If everyone in the room were to shake hands with one another, how many handshakes would there be?

Begin solving the problem by acting it out and constructing a table.

Example:

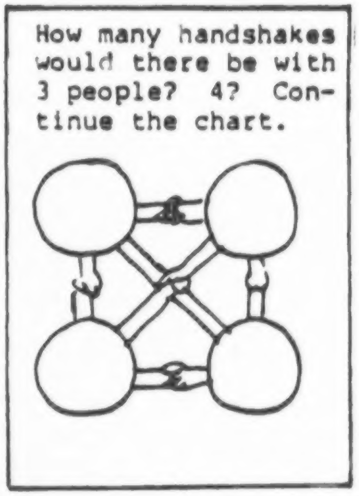
If there were only 1 person in the room, there would be no handshakes.

PEOPLE	HAND-SHAKES
1	0



With 2 people, there would be 1 handshake.

PEOPLE	HAND-SHAKES
1	0
2	1



How many handshakes would there be with 3 people? 4? Continue the chart.

Solution: Let "n" represent the number of people in the room. Multiply the number of people in the room times the number of handshakes each person will make -- (n - 1) because the person shaking hands will not shake his own hand. Then divide by two because one handshake represents two people.

$$\frac{n\,(n-1)}{2}$$

PROBLEM-SOLVING STRATEGIES

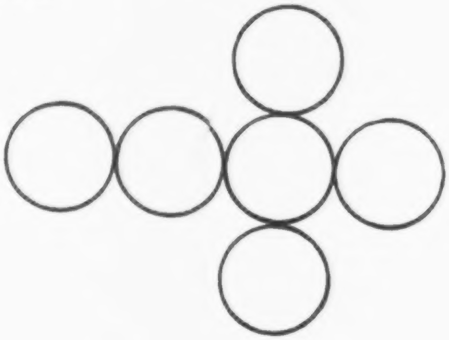
13. Uses logical thinking (reasoning) to solve problems.

The process of reasoning is basic to all mathematics. Mathematics is first and foremost a way of thinking, rather than a body of facts. It may be said that students will be better logical thinkers if they practice logical reasoning. Getting them to stop and think, to consider the consequences of their actions, to plan ahead, and to consider multiple alternatives is another important area of problem solving.

At all grade levels, students benefit from experiences that help them gain clarity, precision, and conciseness in their thought processes. The beginning approach to logical thinking needs to be informal. There should be many opportunities for students to explore and manipulate concrete objects, to identify likenesses and differences, to classify and categorize, and to state generalizations. Oral experiences using terms that are integral to logical thinking need to be provided. These terms include all, some, none, if, then, etc. In this way, students can gain familiarity with this language of logic in non-mathematical contexts.

1. Present the problem: ROWS OF MONEY OR OBJECTS

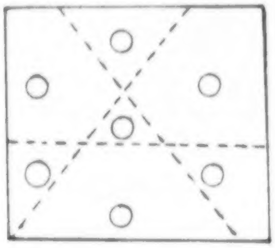
Six quarters or counters form a row and a column. The column has three quarters or objects and the row has four quarters or objects. Move one coin to make a row and a column each having four quarters or objects.



Solution: move coin at end of long row and place on top of coin in center.

2. Play: PEN THE PENNIES!

With three straight lines separate all the pennies.



Dotted lines represent the solution.

3. Play: GUESS MY WORD

One player thinks of a three-letter word for the other to guess. Whenever the person guesses, the player who thought of the word tells whether the guess comes "before" or "after" the word alphabetically.

(Play a sample game with the class first, and then allow partners to play the game several times.)

4. Play: LOGICAL BREAKFAST

Steven, Doreen, and Jay each ate something different for breakfast. One had granola, one had scrambled eggs and toast, and one had a banana split.

Jay did not have scrambled eggs and toast or a banana split.
Doreen did not have scrambled eggs and toast.

Whose parents were on vacation? (Doreen's)

(The one who had the banana split because there was a very lenient babysitter while the parents were away on vacation.)

INSTRUCTIONAL ACTIVITIES
BY DOMAIN

I. SETS

A. Understands the concept of sets.

I-A, 01

1. Display a mixture of large and small blocks. The shapes should vary, but the color should be the same, at least for the initial experiences. Have two students come forward and have each choose a block. Have them compare the sizes and tell if they are about the same or different in size. If they are the same size, hold up a block of contrasting size and help them decide whether they have big or little blocks. If the students have different sized blocks, have them decide which one is big and which one is little. Use these blocks to start two piles. Have the other students take turns sorting the remaining blocks into the piles according to size.

I-A, 01

2. Draw or cut from magazines or workbooks pictures of different objects. For example, baseball caps, footballs, flags, trees, cups, etc. For each set be sure to include two objects that are identical and some that are not. Have students find the pictures that are exactly alike.

I-A, 01

3. Make a folder game. On one side of a folder put two pictures that are the same, on the other side put two pictures that are different and label each side "same" and "different." Prepare eight cards that have two pictures that are the same, and eight with two pictures that are different. The student decides on which side of the folder each card should be placed.

I-A, 02, 03

4. Give descriptions of sets and have students identify the members.

Examples:
a. The set of all students in the room wearing red sweaters
b. The set of all students in the room
c. The set of all boys in the room
d. The set of all green crayons in the box

Ask students to help think of other descriptions to use. Allow students to create sets, then ask other students to describe the set.

I-A, 02

5. Place a set of objects in a sack and give hints about what the sack contains. Have someone guess what the set is.

I-A, 02, 03, 05

6. Involve a few students at a time in making sets. Use small items which may be handled easily. Ask students to select a set of:

    a. things that are hard
    b. things that roll
    c. things that are soft
    d. things that make noise

    Ask each student to use a piece of colored yarn to circle his/her set; then tell about the set, classify it, and name the members.

    Now ask students if other things could be members of the set. Would a baseball be a member of a set of things that are soft? Have students name other things which would or would not be members of the different sets they have made.

I-A, 03

7. To help students think about sets in their personal lives, have them make scrapbooks by cutting out sets of pictures to represent members of the family (including themselves), pets, furniture, clothes, toys, cars, etc.

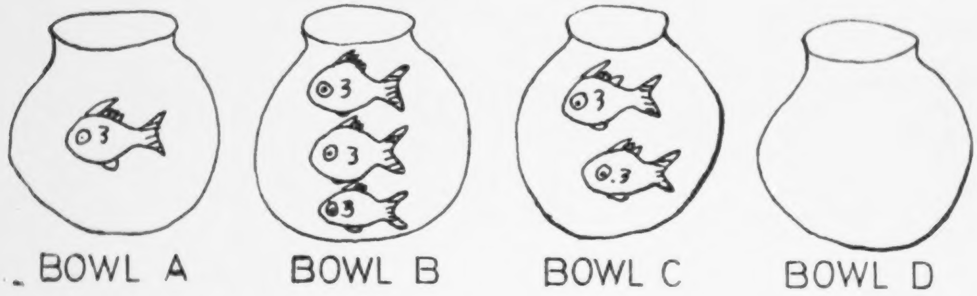
I-A, 03, 05

8. Make cards showing sets of objects. On each card, include four objects with a common attribute or function and one object that does not belong to the set. Have students tell which object does not belong in each set and explain why.

    Variation: Use the students themselves or concrete objects as the members to be described.

I-A, 04

9. Display a picture similar to the one below. Ask questions such as, "How many fish do you see in A, B, C, D?" The answer will be "none" for D. This is an empty set.



I-A, 04

10. Place four dishes on a table or desk. Fill two of them with one to five objects, such as buttons or coins. Leave two of them empty. Ask students which dishes contain zero things. Also, inquire about the number of objects in the other dishes.

Variation: Use ziplock bags with objects--have one empty set.

I. SETS

B. Understands cardinal numbers.

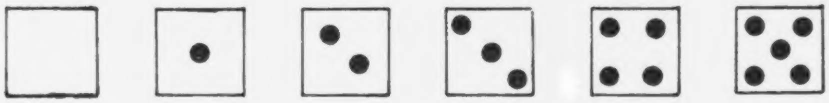
I-B, 01, 03, 04

1. Play the game "Secret Number." Whisper the number 4 to a student (or have him/her draw a word card from a pile). The student chooses that number of counters from a box, displays them to the other students, and asks, "What is the secret number?" The student who is chosen to respond says, "The secret number is 4 because you have four counters," and writes the numeral on the chalkboard. Play the game several times.

   Extension: Sets may include more than ten members.

I-B, 02, 03, 05

2. Give each student twelve blank cards. Have students make dot cards for the numbers 1 though 5. Leave one blank for zero. Example:



   On the remaining six cards, have students write the numerals 0 through 5. Have students use the cards for a matching game played individually, in pairs, or in small groups.

   Extension: Sets may include more than ten members.

I-B, 01, 02, 05; I-A, 04

3. Provide a set of small containers with numerals written on them. Have students place the correct number of counters in each container.

   Variation: Provide a container with "zero" written on it.

I-B, 01, 02, 05

4. Make a set of paper rabbits (with numerals 0-10 as shown below) and a set of paper carrots with corresponding dots (0-10). Tell students: Ricky Rabbit loves carrots, but he is fussy about the carrots he will eat. He will eat only carrots that have a set whose cardinal number matches the numeral on his belly. Can you help him find the correct carrots? Match each rabbit to the correct carrot. Hurry, because Ricky becomes very grumpy when he is hungry.

I-B, 03, 04, 05

5. Provide each student with six to eleven paper cups. In each cup there are either zero objects or some number up to ten. Students pick a cup and determine the number of objects in the cup and write the numeral that names the number of objects. Students continue this activity for every cup. You might write the correct numeral on the bottom of each cup so that students can check their work.

   Extension: Sets may include more than ten objects.

I-B, 06

6. Provide students with beans and dot paper. Say a number. Students should place that number of beans on their dot sheets. Ask students to add enough beans to make larger numbers (e.g., 3, 5, 7, 8, 10).

I. SETS

C. Orders and compares sets.

I-C, 01

1. Provide each student with 2 to 5 counters (e.g., tongue depressors) and the same number of different colored crayons. Students are to match one counter with one crayon and color the counter. Repeat this activity with a different number of counters and crayons.

I-C, 01, 02, 03

2. Display a row of 1 to 5 chairs. Ask five students to stand near the row of chairs. Ask questions such as "Are there more students than chairs? How can we show that the number of chairs and the number of students are the same?" (One student could sit in each chair, etc.)

I-C, 01, 02, 03

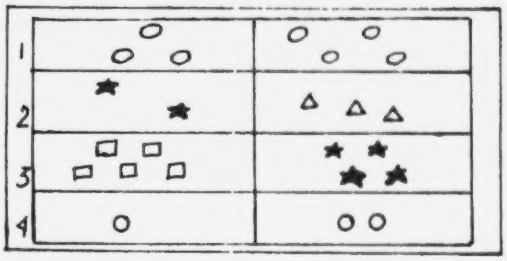
3. Give each student two groups of counters (e.g., 5 blue, 5 yellow). Have students match the counters of one color with those of another to see if there are the same number of counters in each group. Repeat with nonequivalent sets (e.g., 3 red, 2 purple) and ask students to indicate which set has more or fewer.

I-C, 02

4. Provide students with an odd number of counters. Have students make two sets using all of their counters. Ask them to identify the set that has more or fewer.

I-C, 02

5. Provide a worksheet similar to the one below



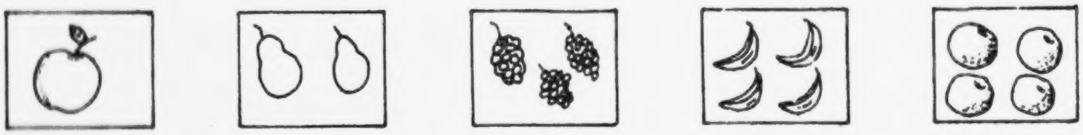
Give students a crayon. Direct them to put an X over the set that contains more and a circle around the set that contains fewer. Do several of these together to make sure the students understand the concept of more and less.

I-C, 03

6. Provide students with several paper cups and index cards with tally marks. In each cup are either zero, one, two, or three objects. Students are to match the number of objects in the cups with the tally marks on the index cards. (A blank card will match the empty cup.)

I-C, 03

~~7. Using a set~~ of 42 cards like the ones shown below, have students play in groups of two to four. One student shuffles the cards, deals seven to each player, and turns the rest face down in a pile. The players take turns turning up a card from the pile. For each card turned up, each player discards a matching card. Any player who does not have a matching card in hand must draw from the pile until getting one. The first player to run out of cards or the player with the fewest cards at the end of the game wins.



I-C, 03

8. Make 2 sets of cards. On the cards draw sets of objects containing 0 to 5 members. Play Concentration. Place the cards face down. The player turns over two cards. If the cards match, the player keeps the cards and takes another turn. If the cards do not match, turn the cards face down again. Play until all cards have been matched. The winner is the player with the most cards.

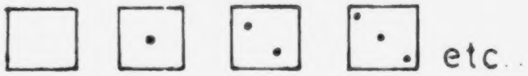
I-C, 04; I-B, 02

9. Place one to ten counters in different containers. Ask students to place the containers in ascending or descending order.

Variation: Students can place the correct number of counters in containers labeled 1 through 10 and then place the containers in order.

I-C, 04

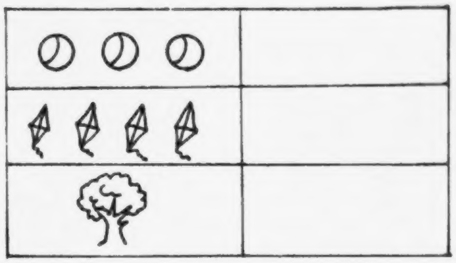
10. Make dot cards for the numbers 0 to 10. Shuffle the cards and have students order the cards in ascending or descending order, etc.



I-C, 05

11. Provide students with a work sheet similar to the one below. Have students use the area next to each picture to form a set with one more. This may be done by using counters, drawing, or cutting and pasting pictures from magazines.

Reverse the worksheet placing the objects on the right, and give directions for the concept of one less.



II. NUMERATION
A. Demonstrates counting skills.

II-A, 01

1. Record counting sequences on a tape recorder. Provide counters and construction paper to place the counters on. The students will count along with the tape recorder, putting a counter onto a square of paper as each number is recited. When the tape is finished, replay it and have students check each other's papers, counting the squares along with the tape.

II-A, 01

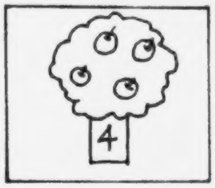
2. Use shapes of different patterns to represent each number (1 to 10)

   Example: 1 star, 2 apples, 3 flags, 4 trees, etc.

   Have students sort the pieces into like groups and count the members in each set.

II-A, 01; II-B, 01

3. Cut approximately 55 small apples out of red felt and ten tree tops out of green felt. On ten pieces of tagboard or posterboard color a brown tree trunk and paste a green tree top on it. Write a numeral (1-10) on each tree trunk. Have students place apples on each tree to match the numeral on the tree trunk.



II-A, 02, 03

4. Have students count how many steps they must take to go from a given point in the room to various other locations (e.g., pencil sharpener, wastebasket, a table, the door, etc.). List the locations and the number of steps on chart paper. Then play a game by having the students ask to go to these locations by saying for example, "I want to take eight steps."

II-A, 02; II-B, 01

5. Teach students the song Ten Little Indians. Place large numeral cards (1-10) on the chalkboard. As the class sings the song, have one student point to the appropriate numeral. Allow all students to participate in this activity.

II-A, 03

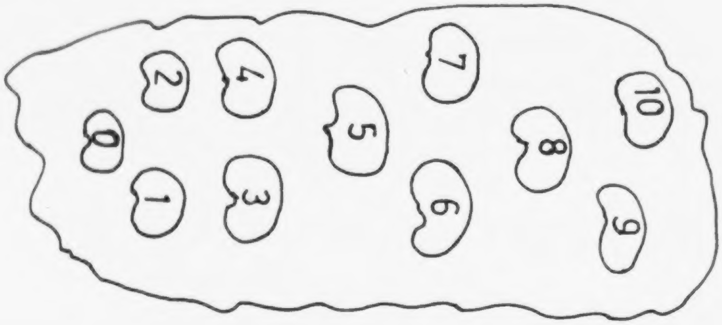
6. Have students form a circle. Have them count the number of heads, noses, mouths, etc. in the group (by ones). Have them count the number of eyes, ears, hands, feet (by twos). Have them put one hand behind their backs and count the number of fingers showing (by fives). Have them count the number of fingers or toes (by tens).

II. NUMERATION

B. Reads and writes number symbols and words.

II-B, 01

1. Cut pieces of cardboard to resemble lily pads. Number the lily pads from 0 to 10. Draw a lake or river on the floor or let the students use their imagination. Place the lily pads in the lake in order from 0-10. Let the students pretend they are frogs. Whoever takes a step out of order falls into the lake.

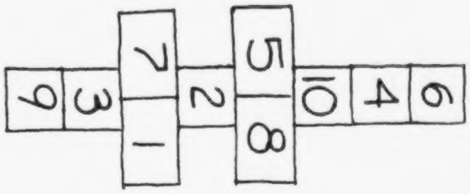


II-B, 01

2. Tape the numerals 1 to 10 on the seat of ten chairs. Have students put the chairs in order for the reading circle or small group activities.

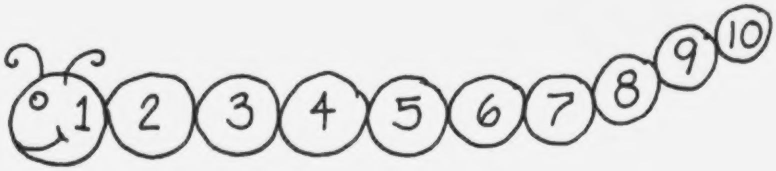
II-B, 01

3. Make a hopscotch game on a large piece of plastic (shower curtain, old plastic tablecloth, etc.). On the hopscotch game write the numerals 1 to 10 in jumbled order. Ask students to read aloud each numeral as they hop on it.



II-B, 01

4. Have students assemble parts of the worm in order.



II-B, 02

5. Provide a box of salt, sand, or grits. Have students practice writing the numerals in sequential order in the sand.

II-B, 02, 08

6. Have students make two sets of cards. On one set they should write the numerals 0-10, and on the other set, the word name for each numeral. Then have students match the cards.

II-B, 03

7. Have students use a hundreds chart. Make 30 cards with directions such as:

   a. move 5 spaces (can be any number)
   b. move back 1 space
   c. lose 1 turn
   d. take another turn

   All players start with their tokens on the numeral one. Taking turns, each player draws a card from the pile and moves his/her token the number of spaces indicated on the card. To stay on that number the player must correctly tell what number s/he has landed on. If the student cannot do so, s/he must go back to his/her prior position.

II-B, 03, 08, 09, 10, 11, 12, 13

8. Prepare several sets of number word cards for multiples of 10 (20 to 90) and several sets of matching numeral flash cards. Distribute numeral flash cards to students. As the teacher or a student flashes the number word card, the other students must hold up the matching numeral flash card.

Variation: Use one set of the same number word cards and one set of the numeral cards to play Concentration. Place cards with words and numerals face down. A student turns up two at a time, trying to make a match. The winner is the person or team with the most matches.

Extension: Make appropriate number word and numeral cards, including all numbers through 100, or through millions, or including billion and trillion.

II-B, 04, 05, 06; II-E, 04

9. Play the card game "Battle" using cards with 3-digit numerals. Have students play in pairs. They must read their numeral card aloud correctly in order to win each round. If both players read the number correctly, the larger number wins the round. The player with the most cards wins the game. This may be extended using numeral cards 1,001-100,000.

Variation: The game can be adapted for comparing two numbers.

II-B, 04, 05, 06

10. Construct a "Number Search" board as illustrated. Call out 3, 4, 5 or 6-digit numerals and have students circle those numerals.

Example: "Four thousand two hundred eight"

0	2	7	6	4	1	3	5
7	3	4	2	0	8	9	6
2	1	0	7	5	3	4	8
6	4	3	2	1	0	9	7
9	0	2	5	4	3	1	8
1	6	7	7	4	8	6	4
8	9	2	0	4	3	2	3
5	3	4	1	0	0	4	3

II-B, 07

11. Make several sets of 10 numeral cards marked 0 to 9. Have students work in pairs. One student should lay out 6 to 8 cards in a row and the other student should read the number shown. Or, have one student call out a number and have the other student show the number using the cards.

Variation: Have students work in pairs. Ask one student to show a number on a calculator and have the other student read the number.

II-B, 07

12. Make a set of 10 numeral cards with numbers 0 to 9 written on them. Shuffle the cards and place them face down. Have a student choose 6 cards. Tape the cards or write the numerals chosen on the board. Have the student read the number that s/he has made from the cards. Ask another student to write a different number from the same cards and read that number.

II-B, 07; II-E, 05

13. Provide students with resource books. Have them find and record the populations of some large metropolitan areas: Chicago, New Orleans, New York, Los Angeles, Washington, D.C., Paris, London, Montreal, etc. Record the population, and rank the cities according to size.

II-B, 07, 12, 13

14. Have students bring to class written material that contains references to large numbers. Have them convert from word names to numerals and from numerals to word names. Examples:

    a. The Gemini 5 and Gemini 7 space ships were the first to rendezvous in space. Gemini 7 set the record for the longest distance traveled in space up to that time: 5,129,400 miles (five million, one hundred twenty-nine thousand, four hundred miles).

    b. During the first 6 months of a recent year the American people flew about 39,366,633,000 miles on commercial airlines (thirty-nine billion, three hundred sixty-six million, six hundred thirty-three thousand miles). This represents a distance of about one million, five hundred sixty thousand times around the earth at the equator! (1,560,000)

II-B, 11

15. Make sets of number word cards for each student. Include "twenty" to "ninety" and "one" to "nine." Call out numbers 21-99 skipping multiples of ten and have students hold up the correct cards.

    Variation: Write the numerals on the board and have students construct the corresponding number words using their index cards.

II. NUMERATION

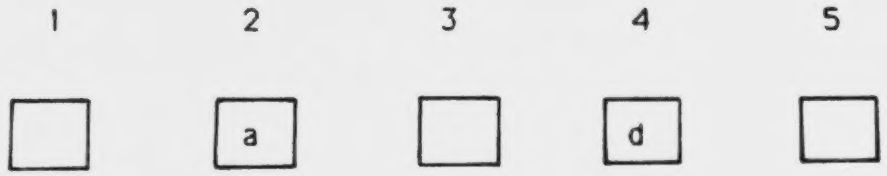
C. Reads and understands ordinal number words.

II-C, 01

1. Have five students line up facing the left side of the room. Ask who is first in line, second in line, etc. Have the students turn around so that the line is now facing the right side of the room. Ask again who is first, etc.

II-C, 01

2. Put five boxes on the chalkboard for a five-letter word. For example: candy. Tell a student to write the letter "a" in the second box. Have another student write "d" in the fourth box. After you have given another letter, ask if anyone has an idea of what the word might be. Finish giving the letters and have a student read the word.



II-C, 01, 02, 03

3. Have students stand in order as if ready to leave the room. Ask questions such as, "Who is second in line?" etc. Continue to identify each position and introduce the words, first, second, third, fourth, fifth, etc.

Extension: Have most of the class line up. Give out cards with ordinal number words on them to the remaining students. Have the students place themselves in line one at a time beginning with the lowest ordinal.

II-C, 01, 02, 03, 04

4. Have students draw and color pictures of animals to be displayed in a parade line on the bulletin board. Have students place a card under each animal indicating what position it holds in the parade line.

Variation:	Use as an oral activity only.
Extension:	Present students with a picture of animals in a parade line. Ask students, "Which animal is second in line?" Or, for an even more challenging task, ask: "If the first animal in line is 20th in a long line, what place does the third animal hold?"

II. NUMERATION

D. Understands whole number sequences and patterns.

II-D, 01

1. The first step in a student's understanding of patterns is to be able to tell where a pattern begins and where it ends. Put connecting cubes or Unifix cubes together to form a pattern. Show it to the students and ask where the pattern begins and where it ends.

   For example: R R B R R B R

   The pattern begins with R and ends with B. (The last R is the beginning of another repetition.)

II-D, 01

2. Students need a lot of experience copying patterns before they can extend them. Show a pattern on the board or overhead and have students copy it. Next, make up cards that have patterns with shapes and have students copy them using concrete objects. After students feel comfortable copying patterns, have them choose the object that comes next or the one that finishes the pattern.

II-D, 01

3. Make different patterns with junk, pattern blocks, beads, chairs, students, etc. Have students identify and continue the pattern.
   Example: boy, girl, boy
   red bead, blue bead, green bead, red bead
   stand, sit, etc.

II-D, 01

4. Computer Activity: The computer software "Moptown" (Creative Publications) and "King's Quest" (Sunburst) are good resources for learning patterns--and both go from basic to advanced levels.

II-D, 02, 03, 11

5. Have students show a number between 1 and 99 with place value materials. Ask them to show the number that is one more or one less by either adding or removing one of the objects.

   Variation: Extend to larger numbers

   Extension: Ask students to show which number would be ten more or ten less, 100 more or 100 less.

II-D, 02

6. Have students draw sets as you give its description such as:
   a. A set of one less than 7
   b. A set of one more than 9

II-D, 02

7. Provide each student with a set of numeral cards 0 to 9. Call out a number (1-99). Have students hold up the cards that show the number that is one more or one less.

II-D, 03

8. Give students place value boards. Have students place number cards (0-9) in the appropriate squares as you call out directions like the following:
   a. Show the numeral that is one less than 200.
   b. Show the numeral that is one more than 599.
   c. Show the numeral that is more than 855 and less than 857.

II-D, 02, 03, 04, 05, 06, 07, 08, 09, 10

9. Divide the group into two teams. Two members of each team go to the board. A number between 0 and 100,000 is called out. One student writes that number and the other writes the number that is one more and the one that is one less. Correct responses score a point.

   Variations: a. Students write the number and the next four numbers in sequence.

   b Students write even or odd numbers in sequence.

II-D, 04, 05, 06, 07, 08

10. Give five students number cards that are sequential. Have one student hide his/her card and ask other students to write which number is missing.

II-D, 04, 05, 06, 07, 08

11. Make a set of 30 cards, each with a number on it. Make sure that the numbers are sequential. Shuffle the cards and give each student a card. Begin with the lowest number and go around the room having students call out their numbers in order.

II-D, 04, 05, 06, 07, 08

12. List six numbers of up to six digits on the board not in order. Ask students to arrange the numbers in order by listing them vertically and comparing the digits.

II-D, 09

13. Place even numbers in a pocket chart, leaving out every other one. Have students place the correct number in the correct spot in the pocket chart.

II-D, 11

14. Give students a hundreds chart. Have them use the chart to supply the missing number.

a. 10, ___, ___, 40, ___.
b. ___, 70, ___, ___, 100
c. 15, ___, 25, ___, 35
d. ___, ___, 50, ___, 70
e. 5, ___, ___, 20, 25
f. ___, 70, ___, ___, 85

II-D, 09, 10, 11, 12

15. Use a hundreds chart to show patterns in our numeration system. Cover up certain numbers (e.g., all even numbers, multiples of 3, etc.). Ask students what number should be covered next, what number should have been covered before the sequence, and if any other numbers should be listed in between.

II-D, 11; III-F, 02

16. Have students complete the number pattern for each letter of the alphabet. (Example: A = 5, B = 10. . .). When they find the secret messsage, have them come to your desk for a cookie.

A	B	C	D	. . .	X	Y	Z
5	10	15	20	etc.	120	125	130

C	O	M	E		___	___		___	___
15	75	65	25		100	75		65	125

___	___	___	___		___	___	___		___
20	25	95	55		30	75	90		5

___	___	___	___	___	___
15	75	75	55	45	25

II-D, 12

17. Give students series of numbers in which a number (or numbers) does not fit the pattern. Have students circle the number that does not fit the pattern.

Example: 12, 14, 16, 18, ⑲, 22, 24, 26

II. NUMERATION

E. Understands whole number equalities and inequalities.

II-E, 01

1. Use a balance scale to show equality. Write number sentences on the board such as 6 ☐ 2 = 4. Put 6 blocks on one side of the scale and 4 blocks on the other. Ask students how they could get the two sides to balance. Should they add or subtract the two blocks? Give other number sentences.

II-E, 01

2. Write number sentences on the board such as 6 ☐ 2 = 4. Have students draw a number line. Ask them to put their pencil on the 6. Ask: "Where would you end up if you added 2 to the 6? Would you end up at the 4? What if you subtracted the 2 from the 6? Which sign should you use?" Give other number sentences.

II-E, 01, 02

3. Construct one set of sign cards (+, -, =) for each student. Write a number sentence on the board leaving out the +, -, and = signs. Students show the missing sign by holding up one of their cards.

   Variation: Use x, ÷, and = cards.

II-E, 01, 02

4. Give students two sets of cards with numerals 0 to 9 and sign cards (+, -, =). Have students make and record their own number sentences. Students could compare their sentences.

   Example: $\boxed{5}\ \boxed{+}\ \boxed{3}\ \boxed{=}\ \boxed{8}$

   $\boxed{10}\ \boxed{-}\ \boxed{2}\ \boxed{=}\ \boxed{8}$

   Variation: Add multiplication and division signs.

II-E, 01, 02

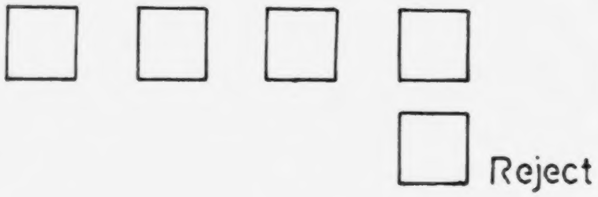
5. Divide students into two groups. Have each team create number sentences without the signs. Students exchange the sentences and supply the missing signs.

II-E, 03

6. Computer Activity: The computer software "Alligator Mix" is useful for teaching the concept of "greater than" and "less than."

II-E, 04; II-F, 04

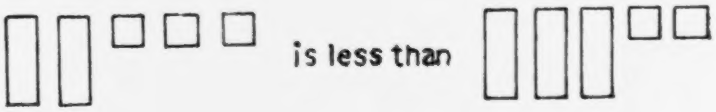
7. Have each student draw a gameboard as shown. Throw a die and have students place the number in a box, with the goal of making the largest four-digit number possible. Repeat four more times. Any number may be placed in the reject box. Once a number is placed in a box, it cannot be moved. The student who makes the largest number wins.



II-E, 03

8. Using 2 sets of concrete objects (counters, children, place value models, etc.), have students tell which is greater or less. Have them verbalize the comparison using "less than" or "greater than."

Example:



II-E, 03, 04, 05

9. A student thinks of a number and writes it down. Another student tries to guess the number by naming a number and then being told whether it is smaller or larger. The student continues to guess numbers until the "secret" number is eventually discovered. Number of guesses needed to discover each number may be recorded and compared.

II-E, 05, II-F, 02, 03, 04, 05; II-I, 01; II-B, 07

10. Make sets of 10 numeral cards with the numbers 0 to 9 written on them; one set for each student. Ask each student to choose six cards and make a number. Ask questions such as the following: Who has the smallest number? Who has the largest number? Who has a number with a 6 in the tens place? Who has an even number?

II-E, 06, 07

11. Display two sets of objects. Have students place the correct symbol (<, >) between the sets of objects and write the number sentence.

II-E, 06, 07

12. To help students remember the direction of the > and < signs, have them put two dots by the larger number and 1 dot by the smaller number and connect the dots.

Example: 6 > 4

II-E,07

13. Write the symbols <, >, =, and ≠ on cards. Put random numerals through 1,000 in a box. Students choose two numerals from the box and place one of the symbols between the numerals.

II-E,08

14. Use a balance scale to show equality or inequality. Give an example such as $5 + 3 \ \square \ 3 + 2$. Put five blocks on the left side, then add three more to them. On the right, put three blocks and then add two more. Have students decide if the two are equal and if not, which side is greater. Then have students write the number sentence using the correct symbol

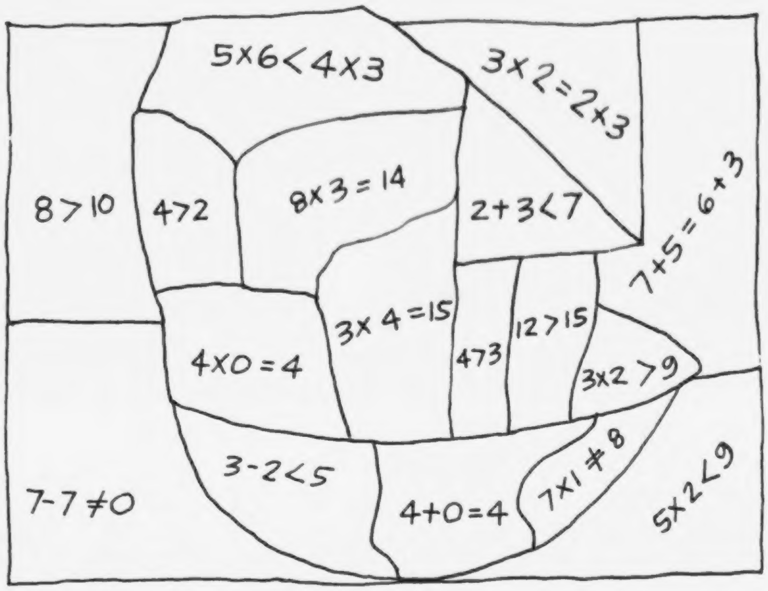
II-E,08

15. Give students ten numeral cards containing the numerals 0 to 9; four operational cards containing +, −, x, + and four relationship cards containing >, <, =, and ≠ . Have them draw four numeral cards, two operational cards, and one relationship card and see if they can make a true number sentence.

Example: 1, 5, 3, 8, +, x, = $5 + 3 = 8 \times 1$

II-E, 09

16. Construct a worksheet as shown below.



Ask students to color true puzzle parts red and color untrue parts blue. The result will be a sailboat.

II-E, 09

17. Divide the class into groups of four. For each group, make index cards showing +, −, x, =, ≠, <, and > signs. Make number cards showing 0 to 9. Ask each group to make number sentences showing true and false equalities and true and false inequalities.

II. NUMERATION

F. Understands place value in whole numbers.

II-F, 01

1. Have students show that ten ones make one group of ten by counting sets of counters. Provide yarn or rubber bands to secure group of ten.

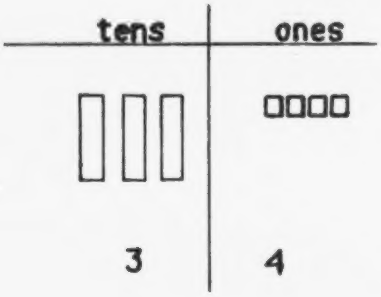
   Variation: Provide cans for each group of ten.

II-F, 02

2. Give each student fourteen counters that can easily be bundled in one rubber band. Have students count to ten, bundling those counters and then count the ones not bundled. Stress that the bundle represents one ten and the separate counters represent four ones. Write the numeral 14, again stressing the meaning of each digit.

II-F, 02, 03, 04

3. Use place value models to represent two-digit numerals on a place value board. Have students write the numerals and explain the meaning of each digit.



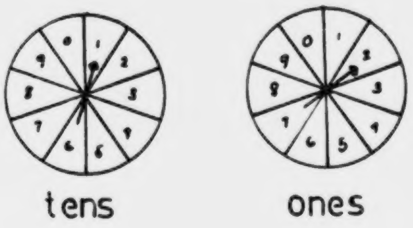
   Variation: Write numerals on the board and have students represent them using place value models.

   Extension: Extend the concept of place value using concrete objects (place value blocks or representations) to include hundreds and thousands.

II-F, 02, 03

4. Spin both spinners (see diagram below) and have students write the two-digit numeral for the number shown by the spinners. Have one student read the number aloud and tell how many tens and how many ones.

   Extension: The activity can be adapted to three spinners to include hundreds place.



II-F, 02, 03

5. "I Am Thinking of a Number" may be played with tens and ones. The student who is "it" might say, "I am thinking of 2 tens plus 4 ones." Another student writes or shows the numeral card for the two-digit numeral (24). If the student is correct, that student becomes "it."

   Extension: This activity may be expanded to include the hundreds place.

II-F, 02, 03, 04, 05, 06

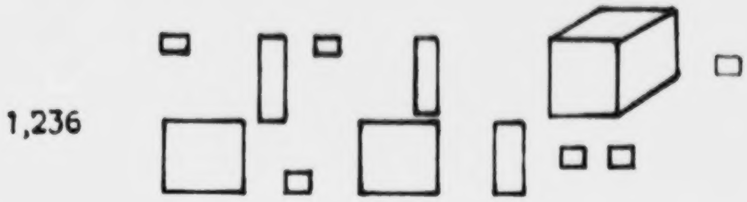
6. Tape off four squares on the floor to represent the ones, tens, hundreds, and thousands place. Have four students stand in the four squares and give each one numeral cards from zero to nine. As you call out a number between 1 and 1000, have each student hold up the correct numeral for his/her place.

   Extension: This activity may be expanded to numbers with five, six, or seven places.

II-F, 03, 04

7. Provide place value materials that represent a three- or four-digit number in random order. Have the students write the numeral.

Example:



II-F, 02, 03, 04, 05, 06; II-B, 13

8. Prepare a deck of cards. On half of the cards, write a 6-, 9-, or 12-digit number (as appropriate to grade level), circling a different digit on each one. Write the names of the place values on the other half of the cards.

612, 340, 908, 562

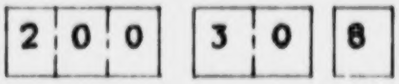
Millions

Deal out all the cards to 3-6 players. Players match digit cards with the correct place value name and lay them on the table. Players take turns drawing from the hand of the person on their right. The person who uses all of his/her cards first wins.

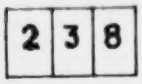
II-F, 03, 04, 05, 06

9. Fold two sheets of paper into thirds, and cut one-third from one of the sheets. Write a multiple of 100 on the full sheet of paper, a multiple of 10 on the 2/3 sheet, and a one-digit number on the 1/3 sheet. Stack the sheets to show a three-digit number.

Example: To show expanded notation separate the papers as shown below.



After stacking the sheets, the result looks like this:



Extension: By repeating the above technique for each period (ones, thousands, and millions), expanded notation can be shown for larger numbers.

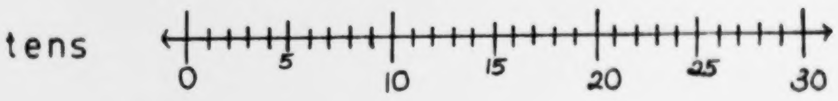
II. NUMERATION

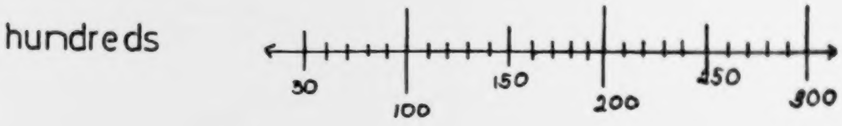
G. Rounds whole numbers.

II-G, 01, 02, 03

1. Place masking tape number lines on the floor--one for tens, hundreds, and thousands. Given a number, the student finds and stands on that point and sees how many steps s/he must make to get to the two nearest tens, hundreds, or thousands. Emphasize that when the distance is equal, students must round up.

Example:





II-0, 01, 02, 03

2. Have each student write the tens numerals on cards (10, 20 . . . 90). Students take turns writing two-digit numerals on the board. Others hold up the card that shows the nearest ten. Repeat with the nearest hundreds for three- and four-digit numerals.

II-0, 01, 02, 03, 04

3. Present rules for rounding. Then discuss situations in which it is better to be exact and situations in which it is better to round off.

   Examples:
   a. One's paycheck
   b. Distance to sun from earth
   c. Bricks in a house
   d. Length of one's foot

   Select situations in which rounding is appropriate and ask students to round.

II. NUMERATION

H. Understands Roman numerals.

II-H, 01, 02, 03

1. Discuss the following chart with the students to show how to change Roman numerals to Hindu-Arabic and vice versa.

Arabic Numerals	1	4	5	9	10	40	50	90	100	400	500	900	1000
Roman Numerals	I		V		X		L		C		D		M
Special Pairs of Roman Numerals		IV		IX		XL		XC		CD		CM	

   1. Add the numbers:
      a. when the numerals are the same: XX = 10 + 10 = 20
      b. when the greater numeral is first: XVI = 10 + 5 + 1 = 16

   2. Subtract when a smaller numeral is before a larger numeral:

      XC = 100 - 10 = 90

   3. A symbol cannot be repeated more than three times.

Have them write Roman numerals for numbers such as:

22 (XXII) 959 (CMLIX) 61 (LXI) 704 (DCCIV) 99 (XCIX)
18 (XVIII) 111 (CXI) 39 (XXXIX) 1300 (MCCC) 49 (XLIX)

Have them write Hindu-Arabic numerals for:

XVI (16) CXX (120) XXIX (29) XLV (45)
XXIV (24) XXVII (27) MCD (1400) MMCCII (2202)

II-H, 01, 02, 03

2. Make a card game using fifty cards. Put a Roman numeral from 1 to 50 on each card. Students play "Battle" using the Roman numerals. This may be extended to play with 1 to 300.

II-H, 01, 02, 03

3. Have such things as a clock face with Roman numerals or a set of reference books numbered with Roman numerals. Have students select a number and give the corresponding Hindu-Arabic numeral. Then ask them to represent in Roman numerals many numbers from their experience such as their lunch money, their age, the number of brothers and sisters they have, the number of students in the class, etc.

II-H, 01, 02, 03

4. Give students some famous dates written in Roman numerals. Have them determine the Hindu-Arabic equivalents and tell why the dates are important. Examples:

a. MCDXCII (1492)
b. MDCVII (1607)
c. MDCCLXXVI (1776)
d. MCCXV (1215)
e. MCMXVII (1917)
f. MCMXLI (1941)

II. NUMERATION

I. Understands factors, multiples, and composites.

II-I, 01

1. Give students six beans and have them pair the beans in twos. Point out that since none is left over, six is an even number. Repeat with an odd number noting that one is left over. Have students experiment with numbers and record whether they are odd or even.

264-2: II-I, 01

2. Give students a set of cards which shows the numbers from 1 to 100 and two boxes, one labeled "Odd Numbers" and the other labeled "Even Numbers." Have students place the cards in the correct boxes.

II-I, 03, 02

3. Give students a hundreds chart. Have them circle every second number. Then have them put an **X** on every fourth number. See if they can develop the rule for divisibility.

II-I, 02, 03

4. Review and discuss the rules for divisibility with students:

   By 2 - If the number ends in an even number.
   By 3 - If the sum of the digits is divisible by 3.
   By 4 - If the number formed by the tens and ones digits is divisible by 4.
   By 5 - If the number ends in 5 or 0.
   By 6 - If the sum of the digits is divisible by 3 and the number is even.
   By 9 - If the sum of the digits is divisible by 9.
   By 10 - If the last digit is 0.

   The game "Buzz" can be played using the divisibility rules. For example, the numbers divisible by 5 are selected as Buzz. The game goes around the room, each person saying a number in sequential order beginning 1, 2, 3, etc. When a number divisible by 5 is reached, the number is omitted and "Buzz" is said in its place.

II-I, 03, 02; II-E, 03

5 Give students a hundreds chart. Play "What number am I?" Give students clues. As clues are given have them cross out the numbers that could not work. Examples of clues: "I am divisible by 3"; "I am divisible by 4"; "I am greater than 20"; "I am less than 30." "What number am I?"

Variation: Give students four numbers such as 18, 21, 36, 44. Give clues so that students can choose the correct number from the set. For example: It is divisible by 3. It is divisible by 9. It is divisible by 4. Which number is it?

II-I, 02, 03; II-E, 03

6. Have students use one of the digits 0 to 9 to complete a given two-digit number so that it is divisible by a given number.

Example: 52 ___ (divisible by 4). The last digit could be 0, 4, or 8 making the number 520, 524, or 528.

Variation: The above activity may also be used to express greater than or less than without using symbols by asking appropriate questions.

II-I, 04

7. Present a chart with the numbers 1 to 100, ten numbers per line. Have students do the following activity:

a. Cross out 1 since it is not a prime number.
b. Circle 2. Cross out all multiples of 2.
c. Circle 3. Cross out all multiples of 3.
d. Circle 5. Cross out all multiples of 5.
e. Continue until all numbers are either circled or crossed out.

The result is the identification of prime numbers.

II-I, 05, 06

8. Have students work in pairs. Taking turns, students think of a number from 30 to 99 and list all the factors in order. Write the factors as a set in numerical order by placing one and the number chosen as the first and last elements of the set. Illustrate with one number before students work on their own.

   Example: 48 {1, ... , 48}.

   Using divisibility rules, note that 2 is the next number by which 48 is divisible. Ask: " 2 x ☐ equals 48?" Now place the 2 and the 24 in the set.

   48 {1, 2, ... , 24, 48}

   Continue with 3 x ☐, 4 x ☐, etc., until two factors like (6x8) or a double factor (6x6) fall next to each other in the set. This gives all possible factors

   48 {1, 2, 3, 4, 6, 8, 12, 16, 24, 48}

   Have students do similar exercises independently.

   Extension: This may be extended to numbers from 100 to 200.

II-I, 05

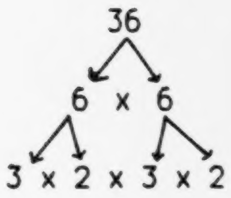
9. Write the following numerals in the sections of a spinner: 16, 18, 20, 24, 28, 30, 32, 36. A student spins the spinner, then lists all the factors of the number indicated. Another student uses an answer key to check.

II-1, 07

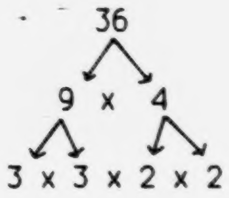
10. Show the students how to do factor trees. Point out that the trees may not be identical but the end result will be.

Example:

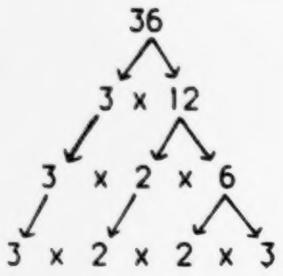
A



B



C



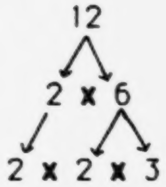
$36 = 2^2 \times 3^2$ $36 = 2^2 \times 3^2$ $36 = 2^2 \times 3^2$

Have students do several factor trees for each of the following composite numbers: 48, 72, 64, 54, 56.

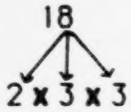
II-1, 07, 10

11. Show the students how to find GCF by using factor trees. Once the prime factors are known, they can be used to determine the GCF.

Example:



and



Show them that the GCF is the product of the common factors or 2 x 3 = 6.

II-1, 10

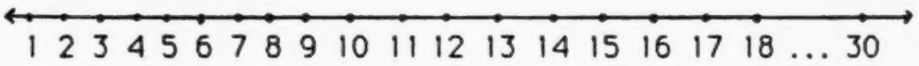
12. Write words such as "madam," "radar," and "wow" on the board. Show students that backward or forward, these words are the same; they are palindromes. Have students name numbers that are palindromes (e.g., 131, 2662, 45954). Then have them find the greatest common factors for each pair of numbers below. They will know if their work is correct if their answers form a seven-digit palindrome.

40, 48	24, 16	72, 81	18, 45	36, 27	40, 32	32, 8
(8)	(8)	(9)	(9)	(9)	(8)	(8)

II-1, 11

13. Give each student number lines like the one below. For each exercise, students use two colors on a number line to show the hops. Then they list the multiples common to both numbers.

a.	Hops of 4 (green).	Hops of 3 (red).	12, 24
b.	Hops of 2 (blue).	Hops of 5 (orange).	10, 20, 30



II-1, 12

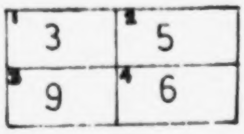
14. Have students find the LCM of the numbers. Write the letter in the box above the answer. (The letters will spell the word "motorcycle.")

E: 4 and 6
Y: 15 and 40
T: 14 and 21
O: 8 and 18
C: 7 and 8
L: 12 and 20
M: 48 and 56
R: 21and 35

___ ___ ___ ___ ___ ___ ___ ___ ___ ___
336 72 42 72 105 56 120 56 60 12

II-1, 12

15. Help the students complete a cross-number puzzle by finding the LCM of the numbers.



Across	Down
1. 5 and 7	1. 3 and 13
3. 12 and 32	2. 8 and 56

As a variation to this activity, students may develop their own short puzzles and exchange them with each other.

II-1, 09, 10, 12

16. Demonstrate this method of finding the GCF and LCM.

Find the GCF and LCM of 28 and 70.

- a. Choose any divisor of 28 and 70 (preferably the largest one).
- b. See if another divisor will divide the new numbers.
- c. Stop when the numbers on the top (quotients) have only 1 as a common factor.

Example:

$$\begin{array}{r|ll} & 2 & 5 \\ \hline 7 & 14 & 35 \\ \hline 2 & 28 & 70 \end{array}$$

- d. The product of the divisors is the GCF (2 x 7 = 14; 14 is the GCF).
- e. The GCF times the product of the top two numbers (quotients) is the LCM - 14 x (2 x 5) = 140.

III. WHOLE NUMBER OPERATIONS

A. Adds whole numbers.

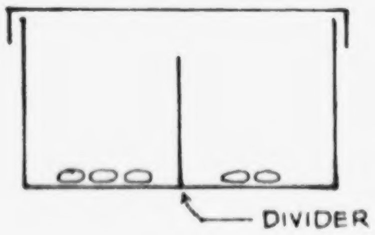
III-A, 01

1. Provide several paper or plastic cups. In two of the cups place one, two, or three objects. Have students examine the contents of these two cups and give the number of the set of objects in each. Then empty both cups into a third cup and have the students give the number of this new set.

III-A, 01

2. Obtain a small box. Cut a piece of tagboard to divide the box into halves The divider should touch opposite sides, but be about half as tall as the box. Tape it securely into place (see cross-section below). Put 2-18 beans in the box, put the cover on the box, and shake the box. Open the box and write the addition sentence that is illustrated. Repeat several times for the same number of beans.

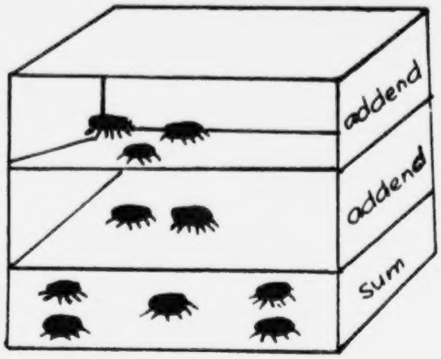
Cross-section of bean box:



3 + 2 = 5

III-A, 01, 02, 03, 18, 19

3. Objects placed on shelves may be used to help students see the vertical order of the demonstrated addends. Three boxes, one placed on top of the other with the open sides toward the class, can serve as shelves. Smaller boxes can be used at the students' desks. Place objects on the top two shelves to represent addends. To perform this operation have students move the two addends to the sum box. Then have students tell how many objects there are and express this relationship by writing its equation.



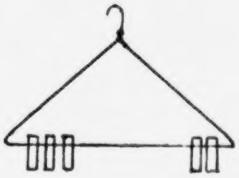
3 addend
+ 2 addend
5 sum

Variation: This activity may also be used to teach zero as the "identity element" in addition.

III-A, 01, 19, 20

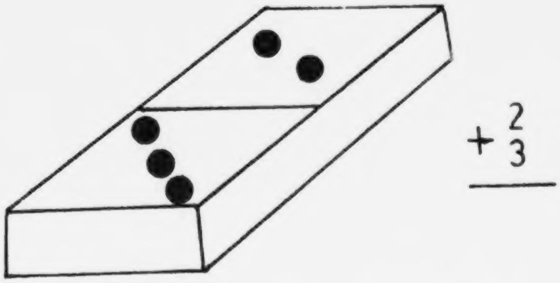
4. Choose a number (e.g., 5) and supply a group of students with that number of clothespins. Have students find different number combinations which express that number by hanging the appropriate number of clothespins on a coathanger. Students should then write the number sentence.

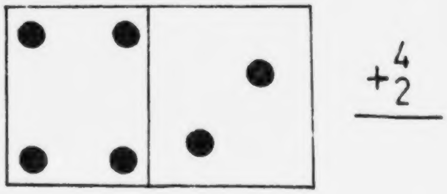
Extension: Turn coat hanger around to express adding in reverse order.



III-A, 02

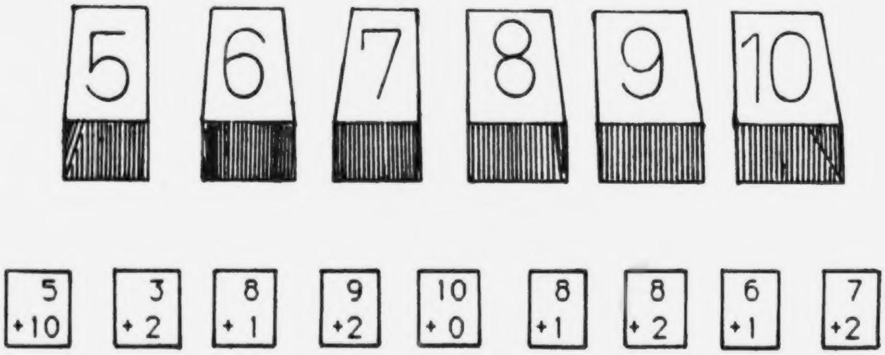
5. Use dot cards or dominoes and have students write the problem or number sentence that goes with each card.





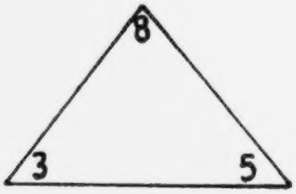
III-A, 02, 03

6. Cut the tops off quart-size milk cartons. Label the cartons with sums up to 18. Make cards with addition problems written on them. Place the cards in a pile and have students take turns putting them in the carton labeled with the correct sums.



III-A, 02, 03; III-B, 02, 03, 16

7. Make triangular flash cards to help students memorize the addition facts



Cover up the top number and ask 3 + 5 = ? and 5 + 3 = ? Cover up one of the bottom numbers and ask 8 - 5 = ? and 8 - 3 = ? Later the cards can be used to show the inverse relationship of subtraction and addition.

III-A, 02, 20

8. Distribute cards numbered 0 through 9 to ten students. Have each student locate the partner whose number, when added to his/hers, will make 9. The two partners come to the board and write two addition statements.

Example: $\boxed{\begin{array}{r} 4 \\ \underline{+\ 5} \end{array} \qquad \begin{array}{r} 5 \\ \underline{+\ 4} \end{array}}$

III-A, 04, 05

9. When students begin to add three or more numbers, adding a "seen" number to an "unseen" number may become a problem. Write a number on the board. Call out another number and have the students add the "unseen" number to the "seen" number on the board. Continue calling out numbers.

III-A, 04

10. Provide 10 blocks. Have students think of various ways to group these objects into three groups: for example, two groups with 4 blocks and one group with 2 blocks. Then have students write the addition sentence for each grouping in horizontal and vertical form and find the sum.

III-A, 04, 05, 10, 14, 16

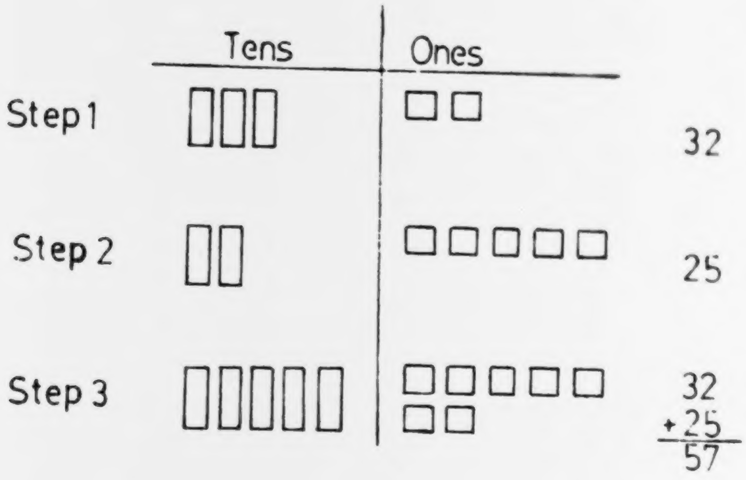
11. Players take turns shaking three beans around in a closed egg carton with one digit (0-5) written in the bottom of each cup. They open the carton to see where the beans fell and write down the sum of those numbers.

Extension:
- a. Use four beans and write one digit (0-9) in the bottom of each cup.
- b. Use larger numbers and 3 or 4 beans to show column addition.

III-A, 06, 11

12. Use place value models and charts. Build the first addend on the chart and write the numbers in the margin (see Step 1). Repeat with the second addend (see Step 2). Combine the two groups one place at a time, beginning with the units and regrouping if necessary. Record the sum as you manipulate the models (see Step 3).

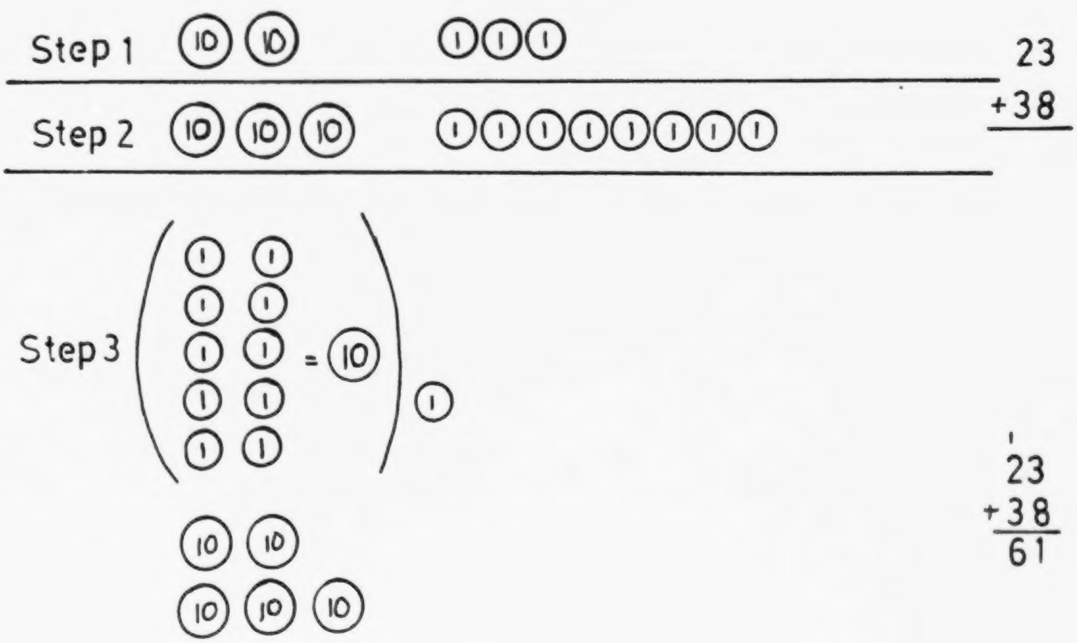
Example:



III-A, 11

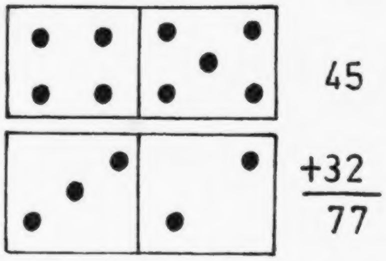
13. Use dimes to represent tens and pennies to represent ones. Explain to students that they must trade ten pennies for a dime whenever possible. For example, begin with 23¢ (2 dimes and 3 pennies)--see Step 1 below. Add 38¢ (see Step 2). Trade 10 pennies for a dime (see Step 3). The sum is 6 dimes and 1 penny, or 61¢. Write the addition sentence.

Example:



III-A, 08, 12

14. Place a set of dominoes face down. Have students take 2 dominoes and arrange them one above the other, to represent tens and ones, then write the addition sentence.



III-A, 07, 08, 09, 10, 12, 13, 14, 15, 16

15. Make the Bean Bag Game. Make two large diagrams as shown below. Form two teams. A student throws two bean bags, one onto each diagram. The student writes the numbers on the chalkboard and adds. A correct answer scores one point for the team.

15	34	8
9	38	21
12	25	19

10	20	30
60	0	50
40	10	20

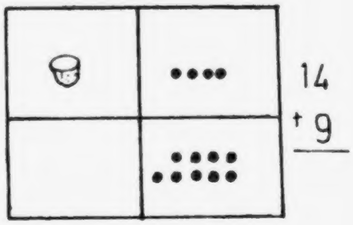
Variation: Make similar game boards to provide practice for adding any two addends with or without regrouping.

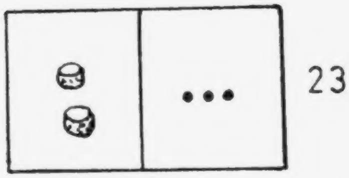
Extension: Make 3 or 4 tosses to practice column addition.

III-A, 11; III-B, 01

16. Make place value boards as shown below. Using beans for ones and cups for tens, ask students to show various addition problems.

Example:





Variation: May be used to show subtraction.

III-A, 12

17. Have student use puzzles similar to those below to add across and down and self-check.

+ Add

36	32	(68)
10	7	(17)
(46)	(39)	(85)

+ Add.

16	43	(59)
21	3	(24)
(37)	(46)	(83)

III-A, 12

18. Computer Activity. The computer software "How to Use the Base Ten Blocks" (Cuisinair) and "Circus Math" and "Addition Logician" (both by MECCA) are good resources for teaching regrouping.

III-A, 16, 17

19. Using 3 x 3 grids, as shown below, ask students to determine which is a magic square by adding numbers vertically, horizontally, and diagonally. If the sums are equal, the square is magic.

4	9	2
3	5	7
8	1	6

(magic)

3	8	6
2	3	5
1	2	3

III-A, 16, 17

20. Assign a value to each letter of the alphabet, as A = 1, B = 2, C = 3, etc. Give a word or a sentence and ask students to find the sum.

Extension: Ask students to find words that are worth exactly 50 or 100 points (e.g., "Prevent inflation" is worth 100 points).

III-A: 18, III-B: 15, III-C: 12, III-D: 08

21. Provide activities identifying the parts of an addition problem. Examples:

Sum 8	
Addend	Addend
2	6
5	___
3	___
7	___
8	___

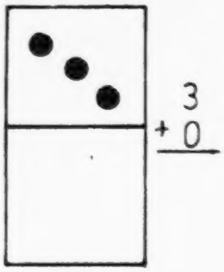
Addend	Addend	Sum
3	4	___
6	___	9
___	3	8
___	___	7

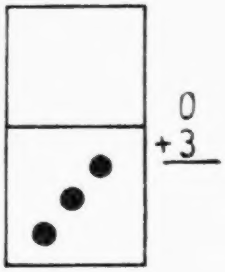
Variation: Use to show parts of subtraction, multiplication, and division problems.

III-A, 19

22. Give students a set of dominoes. Ask them to find the dominoes that illustrate the zero property.

Example:





III-A, 20

23. To assist students in memorizing the addition facts, the concept of the commutative property should be emphasized. Make flash cards containing facts in both orders.

Example:

$$\boxed{\begin{array}{r} 3 \\ +\underline{\ 2\ } \end{array} \qquad \begin{array}{r} 2 \\ +\underline{\ 3\ } \end{array}}$$

III-A (all)

24. Computer Activity: The computer software "Alien Addition" (DLM) is good for timed addition drill.

III. WHOLE NUMBER OPERATIONS
B. Subtracts whole numbers.

III-B, 01

1. Give students counters and a paper cup. Ask them to follow directions such as: "Turn your cup upside down and put 8 counters under it. Take out 3 counters. How many counters are left under your cup?"

III-B, 01, III-A, 01, 06

2. Give students elbow macaroni and string knotted on one end. Have students illustrate subtraction facts. For example, for 6 - 2, students string 6 and move 2 away. Have them count the number left and say the fact aloud.

   Variation: Use for addition problems.

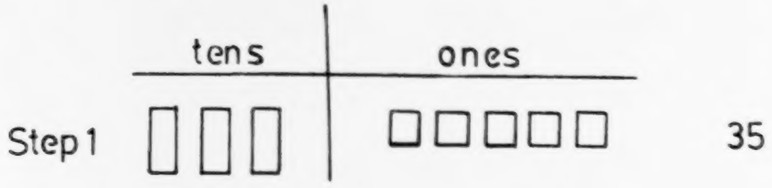
III-B, 01, 02, 03

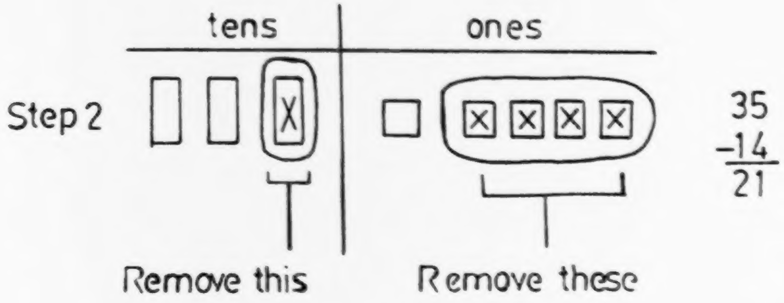
3. Give each student 12 counters and a cube labeled with the numbers 0-5. Each student makes a train of the counters and rolls the cube. The student then subtracts the number rolled and writes the corresponding equation on paper. Continue until the student reaches zero.

   Extension: May be extended to a train of 18 counters.

III-B, 01, 04, 05, 06, 07, 08, 09, 10, 11

4. Use place value models and charts. Build the minuend on the chart and record the number. Record the subtrahend and remove that number of blocks, beginning with units (regroup if necessary). Record the sum as you manipulate the models.





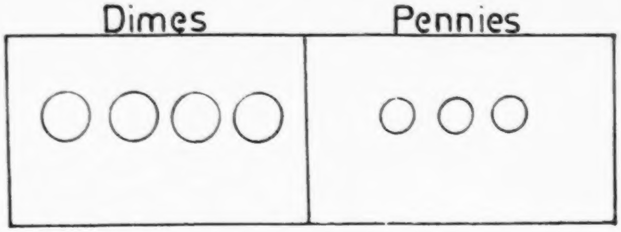
III-B, 06

5. Have students work in threes. One student shows a three-digit number using bundles of sticks (sticks should be bundled in hundreds, tens, and singles). The second student removes some of the sticks (bundles cannot be taken apart). The third student writes the subtraction problem and the answer. Have students take turns performing each task.

III-B, 07

6. Using dimes and pennies, show regrouping in subtraction. Example:

$$\begin{array}{r} 43 \\ -\ 18 \\ \hline \end{array}$$

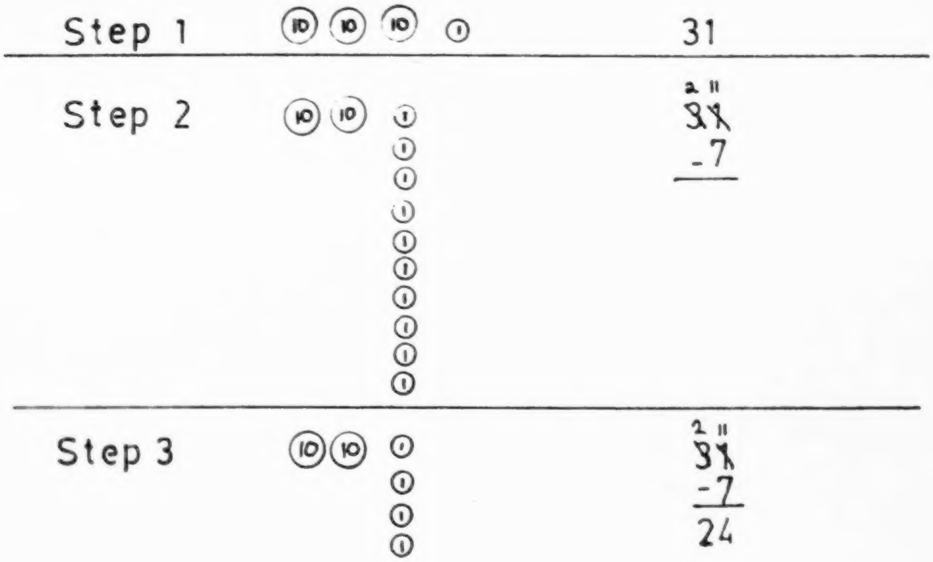


Can you take away 8 pennies? Regroup to 3 dimes and 13 pennies in order to subtract.

III-B, 07, 08

7. Use dimes to represent tens and pennies to represent ones. For example, begin with 31¢ (3 dimes and 1 penny). Write 31 (see Step 1). Take away 7¢ by trading a dime for 10 pennies, resulting in 2 dimes and 11 pennies in the minuend. Record the trade as shown in Step 2. Complete the problem by taking 7 pennies away. The difference is 24¢ (2 dimes and 4 pennies). Record the answer (see Step 3).

Example:


Step 1
31
Step 2
$\overset{2}{\cancel{3}}\overset{11}{\cancel{1}}$
-7
Step 3
$\overset{2}{\cancel{3}}\overset{11}{\cancel{1}}$
-7
24

III-B, 08, 09, 10, 11

8. Once students have been taught to regroup in subtraction problems, they tend to regroup whether it is necessary or not. Give a sheet of subtraction problems with a traffic light drawn on top of each problem. The students must color the light red if they must stop and regroup or green if they can go ahead and subtract.

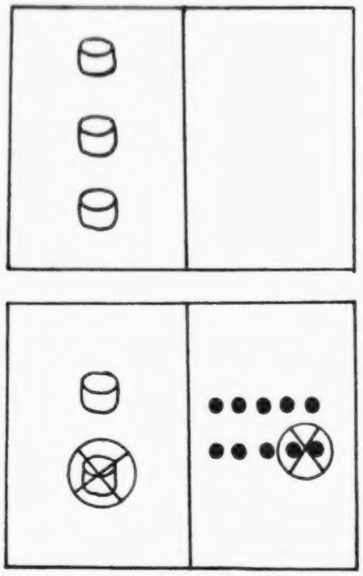
III-B, 12

9. Provide students with bundles of ten sticks and single sticks. Give problems illustrating subtracting zero from two-digit numbers.

III-B, 13, III-F, 01

10. Give students place value boards and counters and word problems illustrating subtracting two numbers with zero in the minuend.

Example: Thirty students were enrolled in the third-grade class. Twelve were absent. How many students were at school?



$$\begin{array}{r} \overset{2}{\cancel{3}}\overset{10}{\cancel{0}} \\ -12 \\ \hline 18 \end{array}$$

III-B, 16

11. Select 3 girls and 2 boys to stand next to each other. Ask the class to make up an addition statement to represent this arrangement ($3 + 2 = 5$ or $2 + 3 = 5$). Next have the boys sit down. What statement describes this? ($5 - 2 = 3$). Now have the boys return to the group and ask the girls to sit down ($5 - 3 = 2$).

III-B, 14, 16, III-A, 20, III-D, 11

12. Divide the class into two teams. Have a member from each team go to the chalkboard to solve an addition or subtraction problem which you provide. As soon as the student finishes the problem and sits down, the next person on that team goes to the board and checks the solution by performing the appropriate operation. If no error is found and the check was done correctly that team receives 3 points. If an error is found and corrected, the team gets 2 points. If the check is done incorrectly on a correctly solved problem, the team receives 1 point. The team with the most points after an indicated period of time wins.

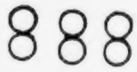
    Extension: Use the same procedure substituting multiplication and division problems.

III. WHOLE NUMBER OPERATIONS
C. Multiplies whole numbers.

III-C, 01

1. Have students make paper chains containing the same number of links.

Example:



2 + 2 + 2 = 6
or
3 x 2 = 6

3 + 3 + 3 + 3 = 12
or
4 x 3 = 12

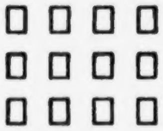
Variation: Use any type of counters to show sets containing the same number of objects.

III-C, 01, 02, 03

2. Have students make trains, stacks, or buildings with connecting cubes or blocks to represent multiplication.

Example: 4 X 3

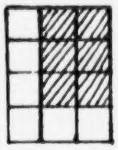
4 stacks of 3



III-C, 02, 03

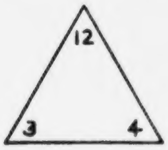
3. Have students shade in grid paper to show multiplication as a rectangular array.

Example: 3 X 2 = 3 rows X 2 columns



III-C, 02, 03; III-D: 02, 03

4. Mutliplication and division can be taught together as fact families and inverse relationships using a triangular flash card.



3 x 4 = ?	12 ÷ 3 = ?	12 ÷ ? = 4
4 x 3 = ?	12 ÷ 4 = ?	12 ÷ ? = 3

III-C, 02, 03

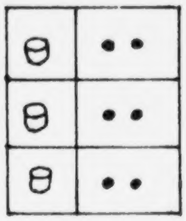
5. Stressing the concept of the commutative property can help students memorize the multiplication facts. Use flash cards showing both facts.

$$\boxed{\begin{array}{r}4\\ \times\ \underline{\ 2\ }\end{array}\qquad\qquad\begin{array}{r}2\\ \times\ \underline{\ 4\ }\end{array}}$$

III-C, 04

6. Give students place value counters and have them model multiplying a two-digit number by a one-digit number.

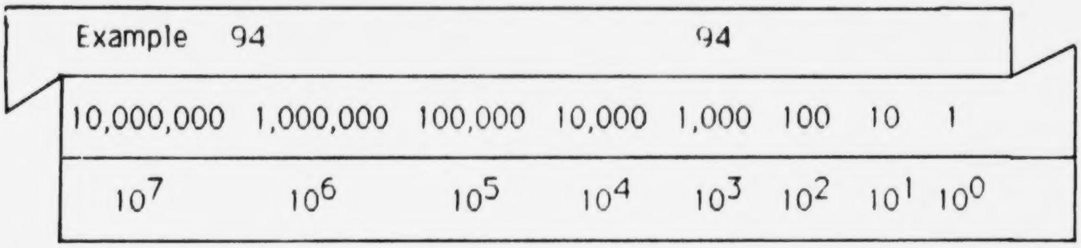
Example:



3 x 12 = 36

III-C, 06, 07

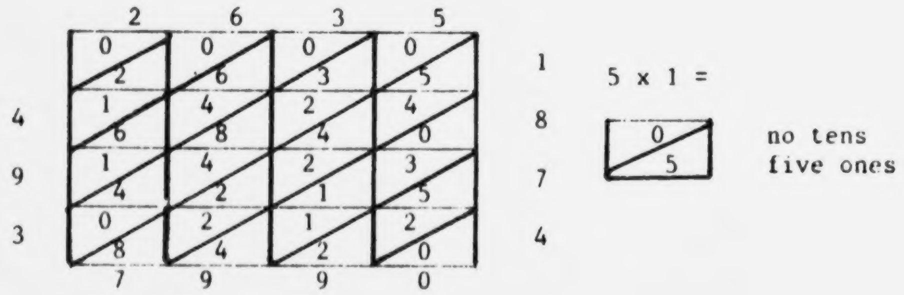
7. Fold and mark a piece of tagboard as shown. Make several cards containing different numerals such as 94 to slide along the crease. Have students write the numerals shown as the numeral card is moved to different positions. (Example: 94,000,000------------------------------9400)



III-C: 08, 09, 10

8. Show students how to do lattice multiplication to vary procedures. To make a lattice, separate a rectangular region into square regions with a lower left to upper right diagonal drawn in each square. Write one factor along the top of the lattice and the other along the right. Example:

```
   2635
 x 1874
  10540
 184450
2108000
2635000
4,937,990
```



Numerals on bottom and left are found by adding the diagonals, carrying when necessary. The answer is 4,937,990.

III-C, 11

9. Have students form five rubber bands into circles on their desks. Then ask them to put one marker in each circle. Ask how many markers there are in all (5). Repeat using a different number of circles with one marker placed in each. Have students explain what happens when a number is multiplied by 1.

III. WHOLE NUMBER OPERATIONS
D. Divides whole numbers.

III-D, 01

1. Using half-pint milk cartons and 15 counters have students fill the cartons so that each has 3 counters. Note the number of cartons and write the corresponding division sentence (15 ÷ 3 = 5).

   Variation: Have students use 3 milk cartons and 15 counters, sharing the counters so that each carton has the same number. Note the number of counters in each and write the corresponding division sentence (15 ÷ 3 = 5).

III-D, 01; III-F, 01

2. Using FLU boards, Base 10 materials, and a problem situation, help students develop the concept of the division algorithm as shown below:

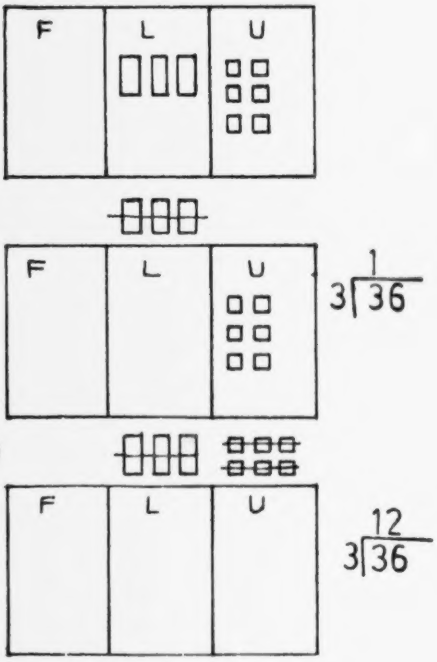
   > The class was going on a hike. There were 36 students in the class. The teacher asked them to form groups of 3 so she could keep track of them more easily. How many groups were there?

   This problem can be written mathematically as $3\overline{)36}$. Put 36 on your board.

   The problem is to put 36 into groups of 3. Start with the longs. Make a group of 3 longs, and put the group up above the board. How many groups did you put up there? (1) Notice where I write that.

   Now go to the units. Make a group of 3 and move it above the board. You have enough to make another group of 3; move that above the board also. How many groups do you have? (2)

   The solution is 12. That means there is 1 group of longs and 2 groups of units in 36 when we group by 3s.



III-D, 01, 03, 04

3 Division needs to be introduced concretely as breaking into equal parts, equal groups, or fair shares. This can be done with blocks, counting chips, or place value materials. Problems with remainders should be included; they are simply seen as leftovers.

For example: Divide 9 M & M's among 3 children.

We have 9 M & M's $\overline{)\,9}$

3 children $3\overline{)\,9}$

Each child gets a fair share $\begin{array}{r}3\\3\overline{)\,9}\end{array}$

9 M & M's are used $\begin{array}{r}3\\3\overline{)\,9}\\\underline{9}\end{array}$

There are 0 leftover $\begin{array}{r}3\overline{)\,9}\\\underline{9}\\0\end{array}$

Do the same with 7 M & M's

7 M & M's $\overline{)\,7}$

3 children $3\overline{)\,7}$

Each child gets a fair share (2) $3\overline{)\,7}$

6 M & M's are used $\begin{array}{r}2\\3\overline{)\,7}\\\underline{6}\end{array}$

There is 1 leftover $\begin{array}{r}2\\3\overline{)\,7}\\\underline{6}\\1\end{array}$

Continued . . .

This can be extended to 3- and 4-digit dividends:

$$6\overline{)728}$$

We have 728 to be broken into six groups.
We want to find how many in each group.

$$\begin{array}{r}1\\6\overline{)728}\\\underline{-6}\\1\end{array}$$

Break the 7 hundreds into 6 groups.
Each one gets 1 hundred with
1 hundred leftover.

$$\begin{array}{r}1\\6\overline{)728}\\\underline{-6}\\12\end{array}$$

Trade the 1 hundred in for 10 tens
and bring down the other 2 tens.
(An arrow may help with this.)

$$\begin{array}{r}6\overline{)728}\\\underline{-6}\\12\\\underline{-12}\\08\end{array}$$

Divide the 12 pieces into 6 groups.
There are 2 in each group with
nothing leftover. If it helps students
to write the zero, allow them to do so

$$\begin{array}{r}121\text{ R }2\\6\overline{)728}\phantom{\text{ R }2}\\\underline{-6}\phantom{\text{ R }2}\\12\phantom{\text{ R }2}\\\underline{-12}\phantom{\text{ R }2}\\08\phantom{\text{ R }2}\\\underline{-6}\phantom{\text{ R }2}\\2\phantom{\text{ R }2}\end{array}$$

Bring down the 8 remaining ones.
These 8 ones need to be divided
into 6 groups. There will be 1 in
each group with 2 leftover.

III-D, 03, 04; III-E, 04

4. Division Target: Write 10 numbers between 100 and 1,000 on the board. Also write 0 to 10 on the board. Give students a target number such as 60, and have them pick two numbers whose quotient will be close to the target number. Pick your targets carefully so that they are within the range of possible answers. This game builds estimation skills as well as gives division practice.

III-D, 05, 07

5. Arrange the digits 1, 2, 3, 4, 5, and 6:

a) to get the greatest possible quotient

☐☐) ☐☐☐☐

b) to get the least possible quotient

☐☐☐) ☐☐☐

III-D, 06

6. Have one student use a calculator and another work the problem in his/her head. See who can get the correct answer faster.

Example problems: 7500 ÷ 10
69000 ÷ 1000
69000 ÷ 100

III-D, 09

7. Using concrete objects demonstrate that division by zero has no meaning. Example: With six objects an infinite number of empty sets may be made; therefore, division by zero has no meaning.

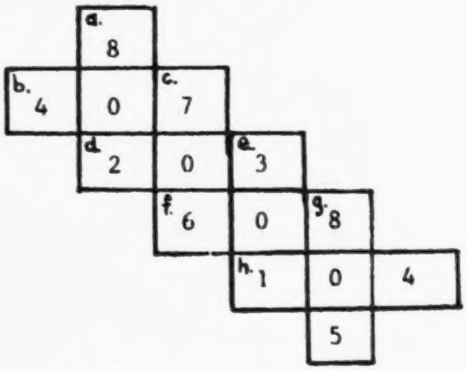
III-D, 09

8. Since students have learned to check division by multiplication, have them apply this skill to prove that zero has no meaning.

Example: 5 ÷ 0 = ? ? x 0 = 5 (no answer possible)

III-D, 10

9 Have students complete a cross-number puzzle such as the following.



Across	Down
b. $32\overline{)13{,}024}$	a. $49\overline{)39{,}298}$
d. $68\overline{)13{,}804}$	c. $95\overline{)67{,}070}$
f. $44\overline{)26{,}752}$	e. $92\overline{)27{,}692}$
h. $26\overline{)2{,}704}$	g. $72\overline{)57{,}960}$

III-D, 10; III-F, 02

10. Have students list different ways the digits 1, 8, 9, 9, 9 can be arranged so that when divided by 9, there will be a zero in the quotient.

Examples of answers:

91,899	99,198	91,989	99,198	91,998	99,918
98,199	99,981	98,919	99,891	98,991	99,819

III-D, 12

11. Use manipulatives to show division with remainder expressed as a fraction:

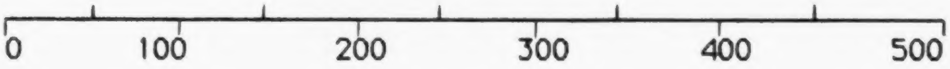
Example: 10 ÷ 3 XXX XXX XXX X = 3 1/3

III. WHOLE NUMBER OPERATIONS
E. Estimates with whole numbers.

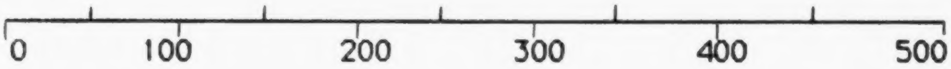
III-E, 01, 02

1. Prepare worksheets similar to the examples below. Make up five problems on the board or overhead. Have students place an **X** on the number line to indicate the estimated sum or difference.

1.



2.



3.

4.

5.

III-E, 01

2. Have two students work together. One student looks in a catalog and selects two to four items. That student estimates the cost to the nearest dollar while the other student writes the prices and finds the exact cost. Have students take turns selecting items they would like.

III-E, 03, 04

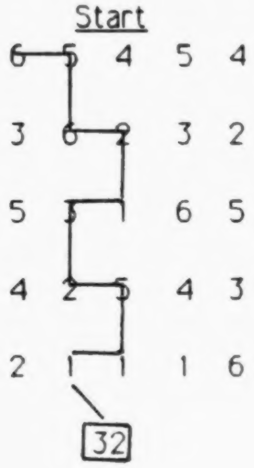
3. Make a set of cards with division and multiplication problems on each. Make a set of similar cards with estimated answers to these problems. Mix the cards and play "Concentration."

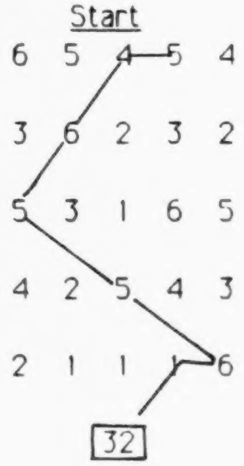
III. WHOLE NUMBER OPERATIONS

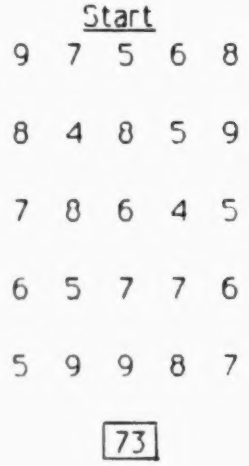
F. Solves problems involving whole numbers.

III-F.02

1. Have students find a path to the answer in the box below the puzzles by adding each number along the path. There are many correct answers.

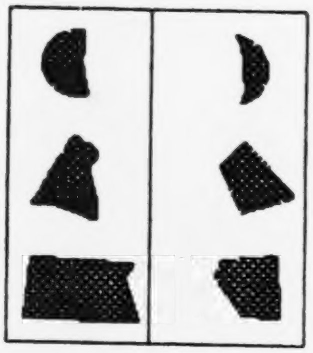






IV. FRACTIONS AND OPERATIONS
A. Understands fractional numbers.

IV-A, 01
1. Provide the students with four or five colored shapes and a piece of construction paper folded down the middle. Have them cut the shapes into two unequal parts. Demonstrate how to make a simple picture graph like the following:



Ask questions that will allow students to identify larger and smaller parts.

IV-A, 01
2. Provide a strip of construction paper, crayons, and scissors. Ask students to cut the strip of paper into two unequal parts. Have them put a red mark on the larger part and a blue mark on the smaller part.

IV-A, 02
3. Give each student a Saltine cracker (or any cracker that is rectangular and has two parts) and a cheese slice. Have them break each into halves and identify each part as one-half before eating.

IV-A, 02, 03
4. Give the students rectangular sheets of paper. Have them fold the papers in half, from side to side, then open the papers and make another fold, from top to bottom. Ask: How many parts when the paper is opened? Are they the same size? Have the students color one-fourth of their papers.

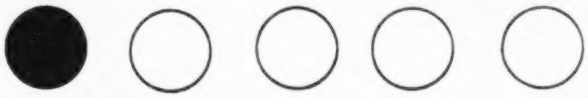
IV-A, 02, 03, 04, 06, 07

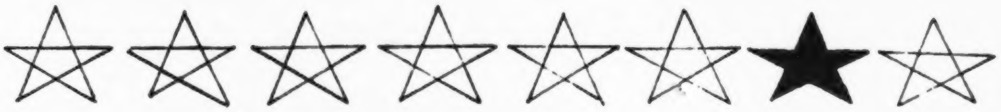
5. Cut out three of the same geometric shapes of equal size. Divide (by drawing) one into halves, one into thirds, and one into fourths. Next, cut the same fractional parts of congruent shapes and place them in a bag. Lay out the whole shapes on a table along with the bag of fractional parts. Students take turns drawing a fractional part from the bag and placing it on the appropriate part of the corresponding whole. The next student must name the fraction represented by the covered part and write it.

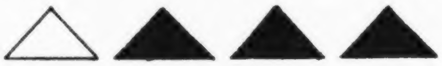
   Extension: Add whole and fractional cards representing fractions with numerators greater than one.

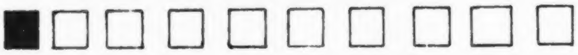
IV-A, 04, 05, 06

6. Using shapes or blocks of different colors, ask students to identify how many in all. Stress that this is called the denominator. Then ask, "what part of each set is different?" Write the fraction.









IV-A, 04, 05

7. Use counters to demonstrate the following:

1/2 of 8 = _____
1/3 of 12 = _____
1/4 of 8 = _____
1/4 of 12 = _____

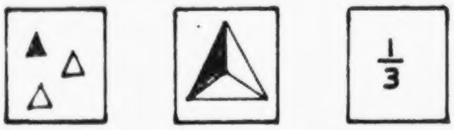
1/5 of 10 = _____
1/6 of 12 = _____
1/8 of 16 = _____
1/10 of 20 = _____

IV-A.04,05,06,07

8. Have each student bring a set of four or more articles such as stamps, coins, shells, stickers, or seeds to school. Have them study their collections and select a number of items to arrange on construction paper. Then have them select a quality such as color, shape, size, age, or texture and tell what fraction of the collection has that quality. Then have them write the fractional symbol they have named.

IV-A.04,05,07

9. Fraction Concentration: Have students draw pictures on two cards for each fraction 1/2, 1/3, 1/4; one picture of part-of-a-whole; and one picture of part-of-a-set.

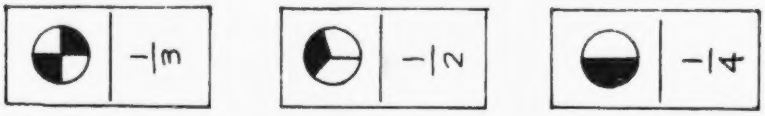


Use the cards to play Concentration. Shuffle them and place them in rows face-down. The first of two players turns over two cards, one at a time. If the two cards name or illustrate the same fraction, the student keeps them. If they do not match, the cards are turned over again and the other student takes a turn. The student with the most cards wins the game.

Extension:	Add a third card for each of the fractional symbols 1/2, 1/3, 1/4. Have students turn over three cards and play Concentration in the same way.
Extension:	Play with matching fractional part and fractional symbol cards representing 1/5, 1/6, 1/8, and 1/10; and later with cards representing fractions with numerators greater than one.

IV-A, 04, 05, 07

10. Prepare dominoes with fractional parts and symbols similar to the ones shown. Have students match the dominoes to make a chain.

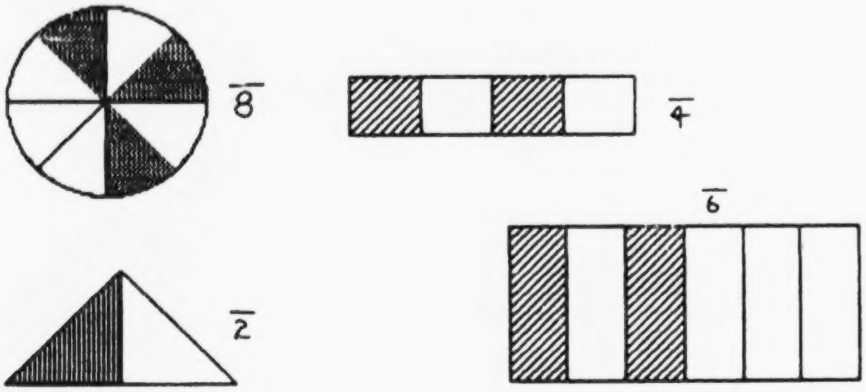


Extension: Prepare dominoes to represent fractional numbers with numerators greater than 1.

IV-A, 08

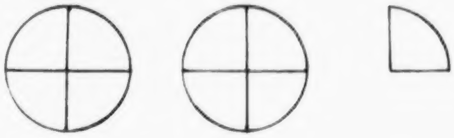
11. Have students supply the missing numerators for the shaded parts. Emphasize that the denominator names the total number of parts.

Example:



IV-A, 09

12. Have students tell how many fourths in 2 1/4 paper plates.



IV-A, 10

14. Have students fold two strips of paper in fourths. Color 1/4 of one and 3/4 of another. Ask which is more, 1 of 4 equal parts or 3 of 4 equal parts. Ask which fraction shows more, 1/4 or 3/4. Develop the idea that 1/4 is less than 3/4.

IV-A, 11

13. Use squared paper, fraction bars, or fraction circles. Have students show 1/3 and 2/3. Ask which fraction is larger. Continue with 1/4 and 3/4, 3/8 and 5/8. See if students can state a rule for fractions with the same denominator. Next have students show 1/2 and 1/3, 1/4 and 1/6, 2/3 and 2/4, etc. See if they can state a rule for fractions with the same numerator. Then show that there is no simple rule if the denominators and numerators are different.

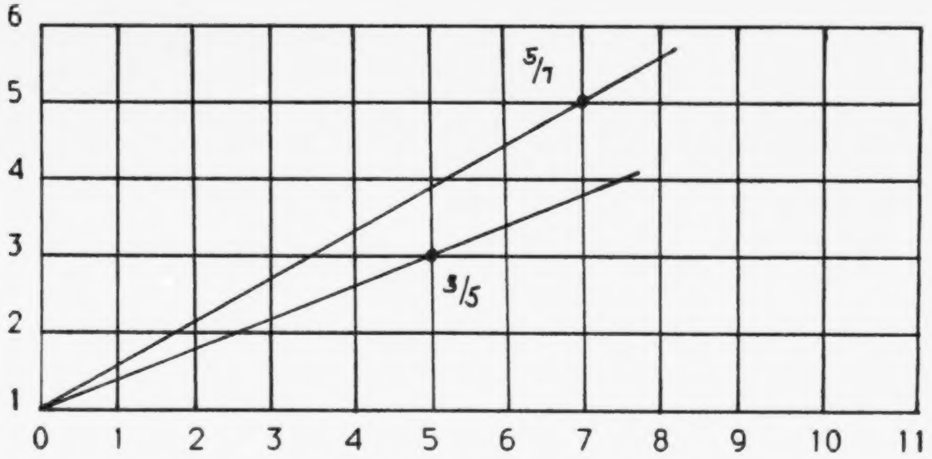
IV-A, 11

15. Give students a list of pairs of fractions. They are to use their fraction kits to find out which of the fractions in each pair is larger. Have them circle the larger one, or write in >, <, or = to make a true sentence.

$\frac{1}{2}$	>	$\frac{3}{8}$	$\frac{5}{16}$	<	$\frac{4}{8}$
$\frac{3}{4}$	=	$\frac{12}{16}$	$\frac{7}{16}$		$\frac{3}{4}$
$\frac{5}{8}$		$\frac{6}{16}$	$\frac{1}{2}$		$\frac{4}{16}$
$\frac{1}{2}$		$\frac{5}{8}$	$\frac{1}{2}$		$\frac{7}{16}$
$\frac{2}{4}$		$\frac{3}{8}$	$\frac{4}{16}$		$\frac{2}{4}$

IV-A, 11

16. Use graph-paper to compare fractions. To compare 3/5 and 5/7, plot the lines for the fractions. The line for 5/7 is steeper than the line for 3/5, so 5/7 is greater than 3/5.

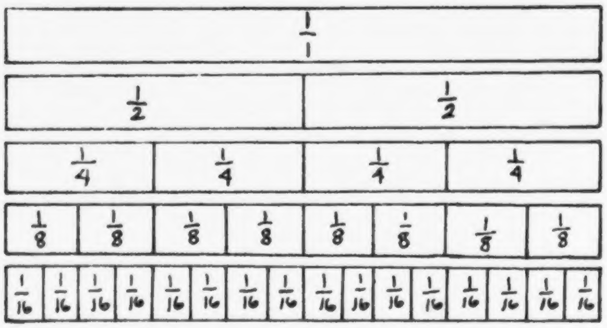


IV. FRACTIONS AND OPERATIONS

B. Expresses fractional equivalencies.

IV-B, 01

1. Divide the class into groups of four. Give each group five 12" X 18" pieces of construction paper (one each of five different colors). Instruct the groups to cut each piece of construction paper the long way into four 3" strips. Each student in the group gets one of each color strip. Have them cut up and label the strips according to your directions, using the colors you indicate. The first strip should be folded in half and cut into 2 pieces; label each piece 1/2. A second strip is folded, cut into 4 equal pieces, and each piece is labeled 1/4. A third strip is cut into 8 equal pieces and labeled; a fourth is cut into 16 pieces and labelled; the fifth is left whole.



Each student now has a fraction kit to use as a concrete model to compare different fractional sizes and develop understanding of equivalent fractions.

IV-B, 01

2. Play "Cover Up." Using the fraction kit, each student starts with the whole strip. The goal is to be the first to completely cover this uncut strip with other strips from the fraction kit. No overlapping pieces are allowed. Students take turns rolling a cube with the six sides labeled 1/2, 1/4, 1/8, 1/8, 1/16, 1/16. The fraction face-up on the cube represents the size of the strip that the student must put on the whole strip. When the game nears the end and a student needs only a small piece, such as 1/8 or 1/16, to cover up and win, rolling 1/2 or 1/4 will not do. The student must roll exactly what is needed.

IV-B, 01

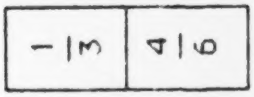
3. Play "Uncover." This activity focuses on equivalencies. Each student starts with the whole strip from the fraction kit covered with the two 1/2 pieces. The goal is to be the first to uncover the strip completely. Students take turns rolling a cube labeled 1/2, 1/4, 1/8, 1/8, 1/16, 1/16. The fraction face-up represents the size of the strip the student must remove. A trade may be necessary before this can be done. For example, if a student rolls a 1/8 on the first roll, one of the 1/2 strips must be replaced with equivalent pieces to the satisfaction of the other players before the 1/8 is removed. A player must roll exactly what is needed to uncover the strip when the game nears the end.

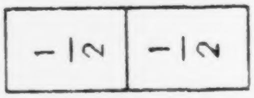
IV-B, 01, 04

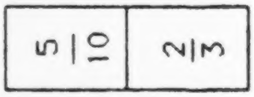
4. Have students fold a square of paper in half and color one half. Have them write the fractions on their paper as the folding continues. They fold 1/2 in half again and write the resulting fraction (2/4). Continue this procedure through sixteenths. Discuss how the colored section did not change with folding.

IV-B, 01

5. Make "Fraction Dominoes" from poster paper and laminate them. Dominoes should contain equivalent fractions.



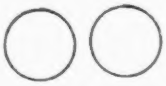
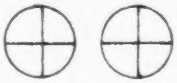




Students play as in regular dominoes, matching equivalent fractions.

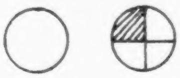
IV-B, 02

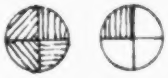
6. Use fraction circles, squares, or bars. Ask students to show the one whole part. Ask them to find other ways to show one whole such as, 4/4, 6/6, 8/8. Ask them to show two wholes and then to find other ways to show two wholes.

2 =  =  = 8/4

IV-B, 02

7. Have students use fraction circles, squares, or bars. Have them show 1 1/4. Ask if there is a different way to show one whole





1 1/4 = 4/4 + 1/4 = 5/4

Reverse the process and have students show 7/4. Ask if there is another way to show 4/4.

Example 7/4 = 1 3/4

7/4 = 1 3/4

IV-B, 02

8. Make a 3" x 4" grid. Write mixed numerals in the sections of the grid. Write corresponding fractions on cards. Have students place each fraction card on the corresponding mixed numeral on the grid.

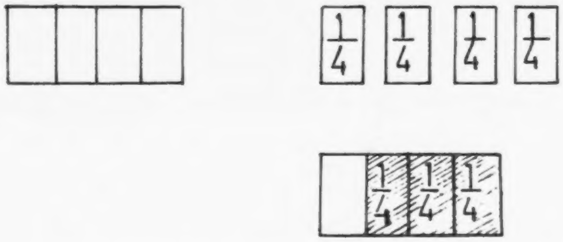
$5\frac{1}{3}$	$1\frac{5}{6}$	$4\frac{4}{5}$	$1\frac{7}{8}$
$1\frac{3}{8}$	$2\frac{2}{3}$	$6\frac{1}{2}$	$5\frac{1}{2}$
$1\frac{1}{2}$	$2\frac{2}{5}$	$3\frac{1}{3}$	$2\frac{2}{3}$

$\frac{12}{5}$	$\frac{15}{8}$	$\frac{13}{2}$	$\frac{11}{6}$
$\frac{5}{3}$	$\frac{16}{3}$	$\frac{10}{3}$	$\frac{3}{2}$
$\frac{24}{5}$	$\frac{8}{3}$	$\frac{11}{2}$	$\frac{11}{8}$

IV. FRACTIONS AND OPERATIONS
C. Computes with fractions.

IV-C, 01, 05

1. Use construction paper or cardboard to illustrate halves, thirds, fourths, fifths, sixths, eighths, and tenths. Draw the fractional parts on one piece. Color and cut the other piece into the fractional parts. Show sums of given problems by placing the cut parts onto the whole. To show 1/4 + 2/4, place one of the fourths on the whole, then two of the fourths on the whole and add.

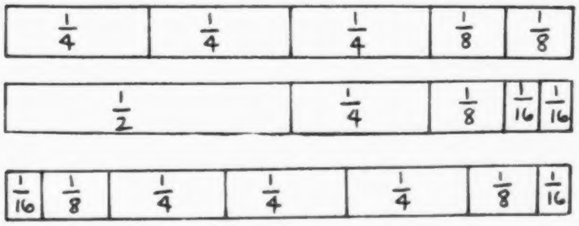


Extension: This may be extended to include subtraction.

IV-C, 01, 02, 03

2. Play "Recording Cover Ups." Ask each student to cover up a whole strip from a fraction kit with whatever smaller pieces they choose. For several of their examples, record what students have done on the board. Then show them a way of shortening these numerical recordings. For example, explain that instead of writing 1/4 + 1/4 + 1/4, they could count the fourths. The three can be expressed as 3/4. Show the same for writing 1/8 + 1/8 as 2/8. Have students help you shorten the other recordings on the board. Then they each cover their whole strip in 10 different ways and record on a worksheet as shown. Students exchange papers for checking.

Example:



$\frac{1}{4} + \frac{1}{4} + \frac{1}{4} + \frac{1}{8} + \frac{1}{8} = 1$

$\frac{3}{4} + \frac{2}{8} = 1$

$\frac{1}{2} + \frac{1}{4} + \frac{1}{8} + \frac{1}{16} + \frac{1}{16} = 1$

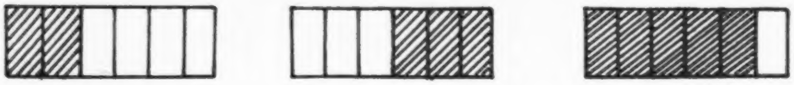
$\frac{1}{2} + \frac{1}{4} + \frac{1}{8} + \frac{3}{16} = 1$

$\frac{1}{16} + \frac{1}{8} + \frac{1}{4} + \frac{1}{4} + \frac{1}{4} + \frac{1}{8} + \frac{1}{16} = 1$

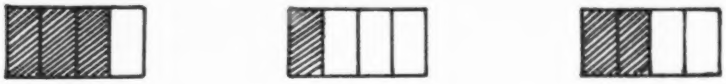
$\frac{2}{16} + \frac{2}{8} + \frac{3}{4} = 1$

IV-C, 01, 05

3. Transparency overlays are recommended. Students can use squared paper to illustrate their own models. Use a model to illustrate 2/6 + 3/6.

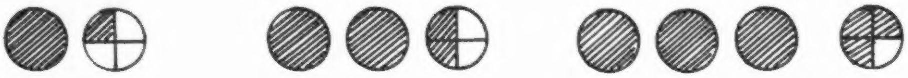


2/6 + 3/6 = 5/6

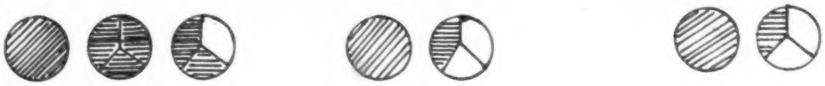


3/4 - 1/4 = 2/4

Use fraction circles.



1 1/4 + 2 2/4 = 3 3/4



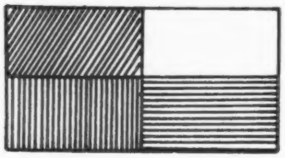
2 2/3 - 1 1/3 = 1 1/3

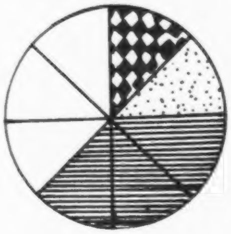
IV-C, 01

4. Have students draw rectangles or circles to illustrate finding the sums.

Examples:

$\frac{1}{4} + \frac{2}{4} = \square$ $\qquad\qquad$ $\frac{2}{8} + \frac{3}{8} = \square$





IV-C, 02, 06

5. Students will write problems in the following algebraic format.

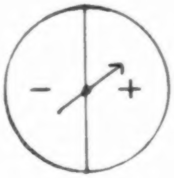
$$\frac{2}{5} + \frac{1}{5} = \frac{2+1}{5} = \frac{3}{5}$$

$$\frac{5}{7} - \frac{3}{7} = \frac{5-3}{7} = \frac{2}{7}$$

IV-C, 02, 06

6. Write pairs of fractions with the same denominators on cards as shown.

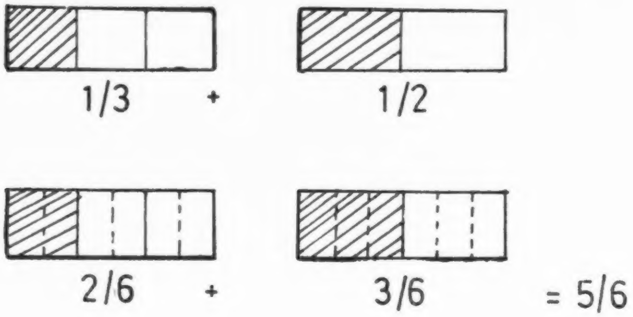
$\boxed{\frac{5}{8} \qquad \frac{1}{8}}$ $\qquad$ $\boxed{\frac{3}{4} \qquad \frac{1}{4}}$

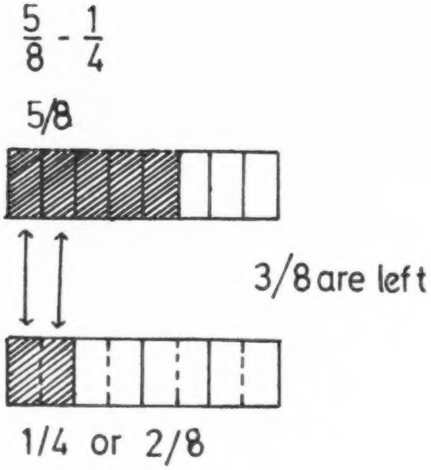


Students choose a card and use the spinner to determine the operation, then find the answer.

IV-C, 03, 07

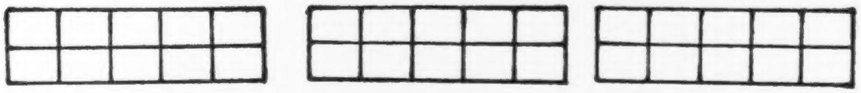
7. Use a model to illustrate adding fractions with unlike denominators (e.g., 1/3 + 1/2). Transparency overlays are recommended. Students can use squared paper to illustrate their own models.





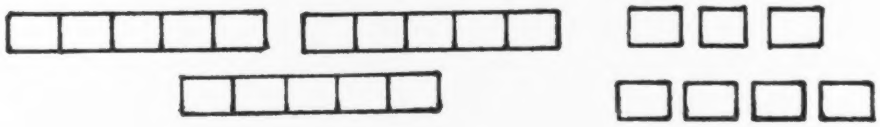
IV-C.04

8 Trim three egg cartons to show 10 equal parts.



Cut another egg carton into 10 individual cups.

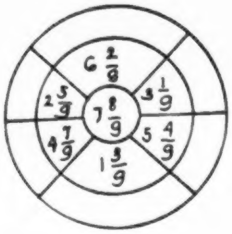
Discuss the fact that the carton is one whole divided into 10 parts. Each cup is one of the 10 parts or 1/10. Three cups would be 3 of the 10 parts or 3/10. Then use the cartons and cups to illustrate addition of mixed numbers as in the following:



Ask a volunteer to group the whole cartons together and group the single cups together to get the answer. See if students can suggest a way to find the answer without the cartons. Arrive at the idea of adding the fractions and then the whole numbers.

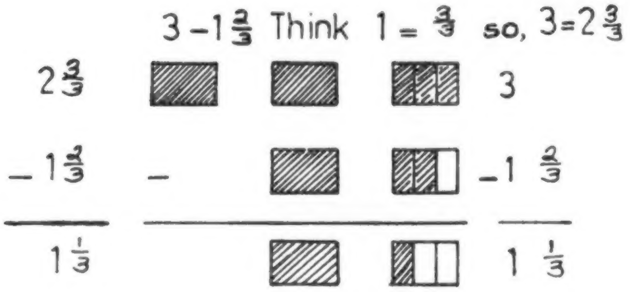
IV-C, 05

9. Have students complete the subtraction wheel by subtracting each fraction in the second ring from 7 8/9 and write the answer in the outer ring.



IV-C, 10, 09

10. Use a model or have students use fractional manipulatives to illustrate the problem 3 - 1 2/3.



IV-C, 08, 10, IV-A, 11, IV-D, 01

11. Tony, Leonard, and Randy keep a record of the number of hours they practice for a race.

Hours of Practice			
Runner	Mon.	Tues.	Wed.
Tony	1 1/2	1 5/6	2 1/3
Leonard	1 1/4	2	2 1/6
Randy	1 3/4	1 1/2	2 2/3

1. How much longer does Tony practice on Tuesday than on Monday?
2. How much longer does Randy practice on Wednesday than on Tuesday?
3. Which runner spends the greatest number of hours practicing?

IV-C, 10, 09

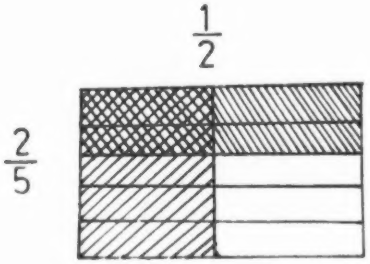
12. Use money to demonstrate subtraction with regrouping. Have students subtract fractional parts such as tenths (dimes), fourths (quarters), halves (1/2 dollars) from 1 whole (1 dollar). Next subtract the same fractional parts from 2, 3, or 4 dollars, and then subtract these parts from mixed numbers.

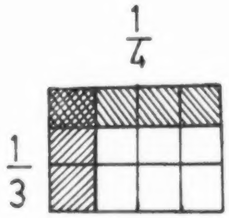
For example: $1\frac{1}{4}$ You have 1 dollar and 1 quarter.

$-\ \frac{3}{4}$ You want to subtract 3 quarters from this amount.
You would change the dollar for 4 quarters. Now you have 5 quarters.

IV-C, 11

13. Have students illustrate answers to multiplication problems with fractions. For example, for 1/2 of 2/5, they will first rule a piece of paper into fifths horizontally and color two fifths. Then they will divide the paper in half vertically and color the half a different color. The fractional part containing *both* colors is the answer. This and 1/4 of 1/3 are illustrated:





IV-C, 12

14 Write problems such as 1/2 of 1/4 on the board. Have students fold a sheet of paper into fourths. Keeping the paper folded, they fold the 1/4 into halves and color one of these halves. Now they unfold the paper to find 1/2 of 1/4. The number of colored parts is the numerator (1). The total number of parts is the denominator (8) 1/2 of 1/4 = 1/8. Have them fold paper to find the answers for these sentences.

3/4 of 1/3 (3 /12 = 1/4)   1/2 of 2/3 (2/6 = 1/3)

3/4 of 3/8 (9/32)   1/4 of 1/4 (1/16)

IV-C, 11, 13

15. Have students make their own fraction flash cards with a multiplication or division problem on one side and the answer on the other. This can be used as an extra time activity to reinforce the skill.

IV-C, 12

16. Give students number lines marked to show halves, thirds, or fourths. (e.g., 0/4 through 16/4). They make jumps on the number line to find the answers to problems such as the following:

4 x 1/4 = (1)   3 x 3/4 = (2 1/4)

7 x 1/4 = (1 3/4)   8 x 3/4 = (6)

IV-C, 12

17. Give students a recipe for "Witches Brew." Have students double the trouble by doubling each ingredient. Simplify results to lowest terms.

Single Portion	Double Portion
4 3/8 gallons spring water	__________
1 1/5 cups ground beetles	__________
2 1/3 teaspoons alligator's tear	__________
3 1/4 bat's wing	__________
6 2/5 monkey's whisker	__________
15 1/4 rat's eyeballs	__________

IV-C, 12; IV-D, 02

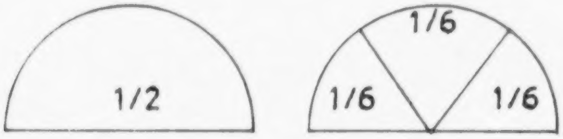
18. Have students bring in their favorite recipes. Tell them they are to pretend that over the next few weeks they will have to prepare the dish for different groups of people. Have them figure how much of each ingredient will be necessary if 2, 3, 5, 10, 18 times the recipe is made.

Extension: Recipes indicate the number of people which given amounts of ingredients will serve. For more challenge, ask students to determine how much of each ingredient will be needed for a given number of *people*.

IV-C, 13

19. Provide each student with six circular cutouts of the same size, each made from construction paper of a different color. Use each color to represent a different fraction. For example, divide and cut all red circles into 2 equal sections. Label each of these sections with 1/2 on one side only. Divide, cut, and label the remaining circular cutouts into fourths, eighths, thirds, sixths, and twelfths. Provide students with divisions in which the divisor is less than the dividend and the quotient is a whole number. Have them illustrate each division with the fractional sections.

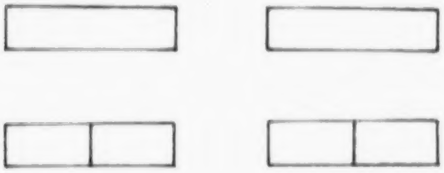
For example, 1/2 ÷ 1/6 means "How many 1/6's are in 1/2?" Students can show that three 1/6 sections cover one 1/2 section and that 1/2 ÷ 1/6 = 3.



IV-C, 14

20. Students will use squared paper to model simple problems.

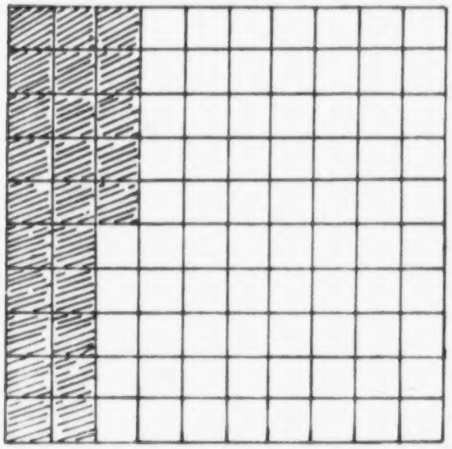
Example: 2 ÷ 1/2



2

How many 1/2's in 2,
or 2 ÷ 1/2 = 4

2 1/2 ÷ 1/2 = 5

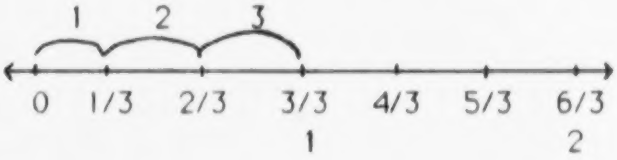


Use 10 x 10 grids. One column is a unit. Shade 2 1/2 units. How many 1/2 units are shaded?

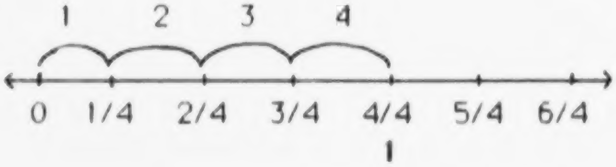
IV-C, 15

21. Students will use a number line to illustrate the multiplicative inverse.

3 x 1/3 = 3/1 x 1/3 = 1



4 x 1/4 = 4/1 x 1/4 = 1



Students will record the steps and explore the pattern of two factors whose product is 1.

IV-C, 15

22. Give students fraction bars or fraction circles. Have them show 3 groups of 1/3. Ask them to put the 3 groups together. Ask: What do you have now? 3/3 or 1? Do this with 4 groups of 1/4, 2 groups of 1/2, etc. This shows that any number times its reciprocal is 1.

IV-C, 16

23. Put some multiplication problems on the board. Have students prime factor the numerators and denominators. They can then remove common factors from the problem.

Example: $\frac{4}{9} \times \frac{3}{10} = \frac{2\cdot 2}{3\cdot 3} \times \frac{3}{2\cdot 5} = \frac{\cancel{2}\cdot 2\cdot \cancel{3}}{\cancel{2}\cdot \cancel{3}\cdot 3\cdot 5} = \frac{2}{15}$

IV-C, 16

24. Put four multiplication problems on the board. Break the class into two teams. Have one team simplify before multiplying; have the other team multiply and then simplify. The first team to give all four correct answers earns 1 point. Keep putting problems on the board, alternating the order of operations assigned to each team.

V. DECIMAL NUMBERS AND OPERATIONS

A. Understands decimal numbers.

V-A, 01, 02

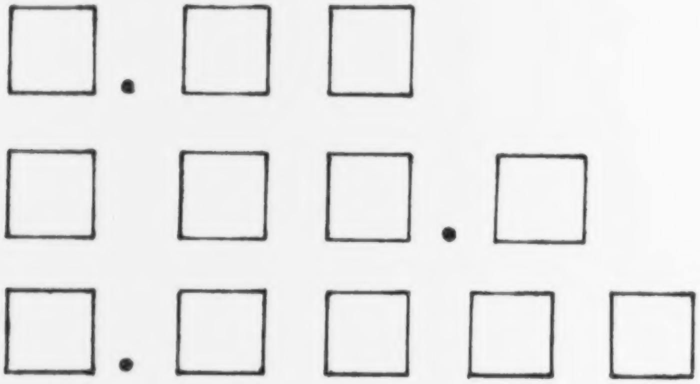
1. Use place value blocks to show decimal numbers to hundredths. The flat (hundreds block) equals 1 whole, the long (tens block) equals 0.1, and the unit (ones block) equals 0.01. Ask students to use the blocks to show certain numbers, or put place value blocks on the overhead and ask students to read and write the number. Stress that the decimal point should be read as "and," not as "point."

V-A, 01, 02

2. Use money to show decimal numbers through hundredths. Put paper money (one, ten, and/or hundred dollar bills), pennies, and dimes in a paper bag. Have a student reach into the bag and grab a handful of money. As s/he calls out what is in his/her hand, the other students should write the number. Ask one student to read the number.

V-A, 01, 02, 03, 04, 08

3. Have students work in pairs. Each student draws three rows of boxes including a decimal point somewhere in each row of boxes. Taking turns, each student rolls a number cube once for each box. After each roll, s/he writes the numeral shown in any one of the boxes. Have students read the numbers shown when all boxes are filled, then compare to identify the smallest and largest numbers.



V-A, 05, 08, 09

4 Give students index cards with selected decimal number words through hundred-thousandths Students will order them from least to greatest or group them into categories greater or less than a given number

V-A, 06

5 Give students paper money and coins. Ask them to show you an amount to be rounded. If you are asking them to round to the nearest one, the amount must be 5 dimes or 50 pennies in order to round up; to round to the nearest tenth, the amount must be ≥ 5 pennies in order to round up

V-A, 06

6 Use place value materials to represent decimal numbers. The flat represents 1 whole unit, the rod represents 0.1, and the unit cube represents 0.01 Give a number and ask students to show the number with the place value materials If you are asking them to round to the nearest one, they must have 5 or more rods to round up; to round to the nearest tenth, they must have 5 or more units in order to round up

V-A, 06

7 Have each student write 10 decimal numbers naming thousandths. Students exchange papers and for each decimal number, write the approximation to the nearest hundredth, to the nearest tenth, and to the nearest whole number They then return the papers for checking

V-A, 06; V-C, 01

8 Have students collect grocery store receipts, round the prices, and estimate the sums, to see how close their estimates come to the actual costs

V-A, 07

9 Have students use place value materials and a hundreds grid. Have one student cover 0.8 and have another student cover 0.80 Ask them to see if the same amounts are covered. Next, have one student cover 0.8 and have another student cover 0.08. Again, ask them to see if the same amounts are covered Show them that 0.8 = 0.80, but 0.8 is not equal to 0.08

V-A, 08, 02

10 Give students hundreds grids. Call out two decimal numbers and have them shade in cells on the grid to represent each number. Then they should compare the sizes of the shaded areas to compare the magnitude of the numbers. Make sure that students write the decimal numbers under the shaded grids.

Variation: Place value materials or decimal squares can be used instead.

V-A, 09

11. Assemble students in groups of four and give each student some paper money and coins. Call out four decimal numbers. Ask each student to write one of the numbers. They must show their number with the money. They then must compare the amounts and put the numbers in order.

Variation: Place value materials may be used in place of paper money and coins.

V-A, 09

12 Give students hundreds grids. Assemble students in groups of four. Call out four numbers between 0.01 and 1.00. Ask each student to write one of the numbers and to shade in cells on the grid to represent the number. Then they should compare the sizes of the shaded areas to put the numbers in order.

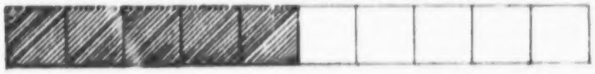
V-A, 09, 02, 03

13 Have students write as many decimal numbers as they can, using the digits 1, 2 and 3. Ask them to write the numbers in order from least to greatest.

V. DECIMAL NUMBERS AND OPERATIONS
B. Expresses decimal equivalencies.

V-B, 01

1. Have students shade in fractional parts on a 10-strip and tell what part is shaded.



5/10 = 0.5

V-B, 01

2. Give each student a grid similar to the following to introduce hundredths and their equivalent fractions. Guide students to see that the whole has 100 parts. Each part is one of the hundred parts (1/100) and that 1/100 may be written as a decimal (.01)

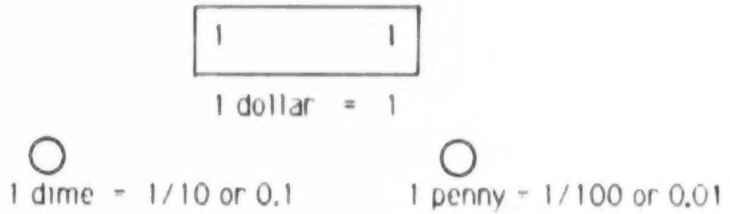
Label each part as .01. Cut the chart into 10 strips to show that 10 hundredths make one tenth. Have them write 10/100 as .10 which is the same as .1 or 1/10

.01	.01	.01	.01	.01	.01	.01	.01	.01	.01

V-B, 01

3 Use 100 pennies and 10 dimes to illustrate hundredths and tenths, respectively. Guide students to manipulate the coins and complete a chart like the following

MONEY MATCH



1 dollar = 1

1 dime = 1/10 or 0.1

1 penny = 1/100 or 0.01

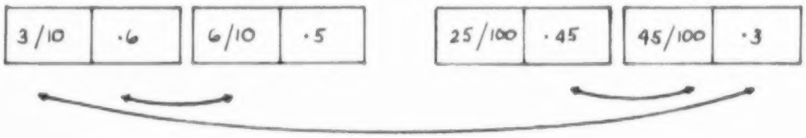
1/2 of 10 dimes = .5
1/5 of 10 dimes = .2
4/5 of 10 dimes = .8
1/10 of 10 dimes = .1
9/10 of 10 dimes = .9

1/2 of 100 pennies = .5
3/4 of 100 pennies = .75
4/5 of 100 pennies = .8
1/10 of 100 pennies = .1
9/10 of 100 pennies = .9

V-B, 01, 02

4 Cut several "dominoes" from tagboard. On one half write a common fraction and on the other half a decimal fraction. The pair of numbers on each domino should not be equivalent. Make four copies of each domino.

Example:



The game is played like regular dominoes. Place all the dominoes face down. Four players may draw four dominoes each. The first player may place any one of his/her dominoes in the center, and succeeding players may match the decimal fraction or common fraction with its equivalent. If a person cannot play, s/he draws another card from the center and play passes on. The first player to use all his/her dominoes is the winner.

V-B, 01

5 Give students several pages of 100-square graph paper Call out fractional numbers Have students shade in the fractional part representing each fraction Then they count the shaded squares to discover the decimal equivalent for each fraction

V-B, 03, 04

6 Have students find the batting averages of the players by dividing the number of hits by the number of times at bat Explain that batting averages are always given to the nearest thousandths; have students report their answers to three places

PLAYER	NUMBER OF HITS	TIMES AT BAT	BATTING AVERAGE
A Glenda	7	22	?
B Betty	9	31	?
C Bill	6	19	?
D Ray	16	45	?
E Bonnie	11	38	?

V-B, 04

7 Have students use a calculator to write 1/8, 2/18, 3/18 17/18 as decimals Have them use a bar to show that the hundredths digits repeat

V-B, 05, 06

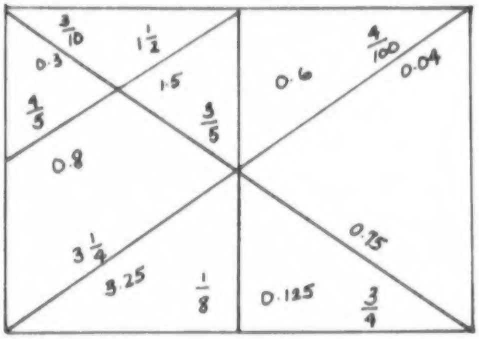
8 Give students paper money and coins Show them that 1 dime can be written as 0 1 of a dollar or as 1/10 Continue with 2 dimes, etc Show them that 1 penny can be written as 0 01 of a dollar or as 1/100 Continue with other amounts of money, including amounts over one dollar

V-B, 05, 06

9. Use a place value grid and place value materials. Let the flat represent one whole (1.0), the rod represent 0.1, and the unit cube represent 0.01. Place 1 unit cube on the grid. Show that this could be written as 1 part out of 100 or 1/100. Continue with other unit cubes. Ask students to put 10 unit cubes on the grid. This would be the same as 10 parts out of 100 or 10/100. The 10 unit cubes could be removed and 1 rod could be used instead. This time we could say 1 part out of 10 or 1/10. Show that the two are the same. Continue with other numbers, including numbers greater than 1. (An overhead grid illustrates this concept well.)

V-B, 05, 06

10. Make a puzzle with equivalent decimal and fractional numbers like the following. Cut the pieces apart and have students match the equivalent values.



V-B, 05, 06

11. Show students how to write a check.

Explain that on one section of the check, the part less than 1 is written in decimal form (as part of the number on the line: "$ ________")

On another part, the part less than 1 is written in fractional form (following number words on the line: "____________________ dollars").

Have students practice writing facsimiles of checks, given various amounts of money.

V. DECIMAL NUMBERS AND OPERATIONS

C. Computes with decimals.

V-C, 01, 02; V-D, 02

1. Duplicate the magic square shown below. Have students supply numbers (those in parentheses) so that the sum along each row, column, and diagonal is the same.

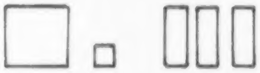
10.55	.05	(7.55)
(3.05)	6.05	(9.05)
(4.55)	(12.05)	1.55

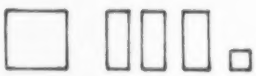
Extension: May be extended to include thousandths.

V-C, 01

2. Have students use place value materials to add and subtract decimal numbers through hundredths. This will be especially beneficial for problems in horizontal format because it will help explain why the decimals are lined up.

1.01 + 0.3 = 1. 3 1





Variation: Money may also be used in the same manner.

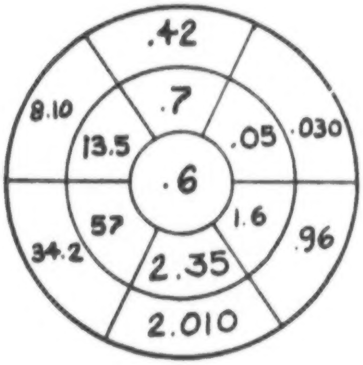
V-C, 03

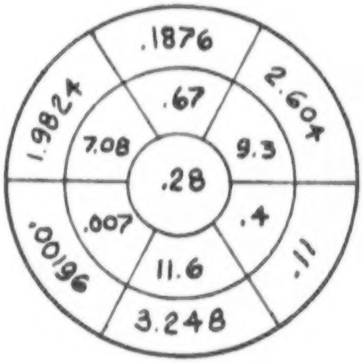
3. Have students choose any two decimal numbers between 0 and 1 and find the product. Ask if the product is greater or less than either of the two factors. Have them repeat the process to see if this is always the case.

Variation: Use calculators and keep a record of problems and results.

V-C, 03

4. Have students complete the outer circles by multiplying the numbers in the center of the circle by each of the numbers in the second ring. They should write the answers in the outer ring (answers are shown in the sample below).





V-C, 04

5. Prepare a number cube with 1, 1, .01, 001, and 0001 on its faces. The game board should look as follows

72.5	48.39	309.1	6.51	62.44
3.091	624.4	725	483.9	65.1
.0651	72.5	6.244	.3091	4.839
.6244	3.091	.4839	.0725	.651

Players take turns. The first player places two markers on the board, one in the top half (first two lines) and one in the bottom half. The markers should be placed on two numbers which contain the same digits, excluding zeros (e.g., 72.5 and .0725). The student decides which of the two numbers is smaller or greater; and names the number that the greater (i.e., 72.5) would be multiplied by to get the smaller (i.e., .0725). S/he then tries to roll the multiplier. If the correct multiplier is rolled, the markers are left in the spaces; if not, removed. The student who covers the most wins

V-C.04

6 Make sets of cards such as the following. Have students arrange the cards to state a true equality.

a $\boxed{6}\ \boxed{\times}\ \boxed{.1}\ \boxed{=}\ \boxed{.6}$

b $\boxed{7}\ \boxed{\times}\ \boxed{.01}\ \boxed{=}\ \boxed{.07}$

c $\boxed{9}\ \boxed{\times}\ \boxed{.001}\ \boxed{=}\ \boxed{.009}$

d $\boxed{13}\ \boxed{\times}\ \boxed{.0001}\ \boxed{=}\ \boxed{.0013}$

e $\boxed{8}\ \boxed{\times}\ \boxed{.0001}\ \boxed{=}\ \boxed{.0008}$

V-C.05

7 Have students use calculators to divide numbers by 10, 100, 1,000, and 10,000. For example, have them divide 25, 862, 536.7, etc.

Discuss the movement of the decimal point in each instance.

8 Have students work the following problems and write the letter that is matched with the answer.

60.7	6.55	.506	.06	6.9	.16	60.7	6.55	.68	.506	6.5

$S = .09\overline{).585}$ $C = 7.1\overline{)48.99}$

$H = .52\overline{).0832}$ $F = .8\overline{)48.56}$

$R = 39\overline{)255.45}$ $N = .41\overline{).0246}$

$I = .4\overline{).272}$ $E = 1.7\overline{).8602}$

VI. PERCENT, RATIO, AND PROPORTION

A. Demonstrates a working knowledge of percents.

VI-A, 01, 02

1. Write this sentence on the chalkboard, "In the apartment building 31 of the 100 windows were open." Have students write a fraction for the number of windows in the apartment that were open. Show that 31/100 may be written as 31% (thirty-one percent). Percent means hundredths. The symbol % stands for parts per 100. We may write a percent as a fraction with a denominator of 100.

   Examples: 31% = 31/100 49% = 49/100 7% = 7/100

   We may write a fraction with denominator of 100 as a percent.

   Examples: 41/100 = 41% 37/100 = 37% 5/100 = 5%

VI-A, 02

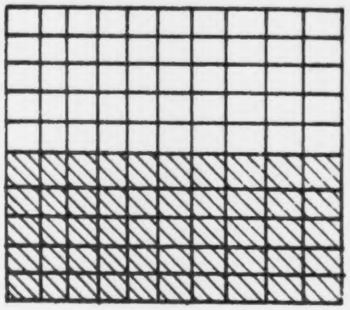
2. Give students a 100-square grid. Write the following on cards:

Red	14%	Yellow	19%	Blue	16%
Orange	12%	Green	15%	Purple	7%
Gold	11%	Brown	3%	Black	3%

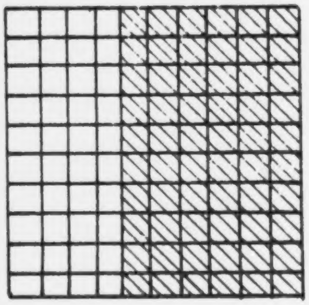
   Students take turns drawing a card and use the indicated color to shade the grid to represent the percent given on the card. The activity may be repeated to make different designs.

VI-A, 02, 06

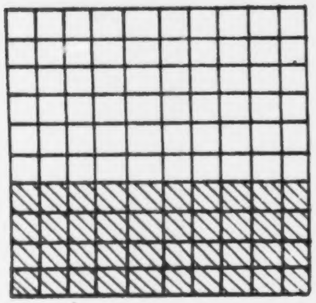
3. Give students hundred squares as shown. Have them shade in fractions with a denominator of 100, then write the percent for the shaded area. For example:



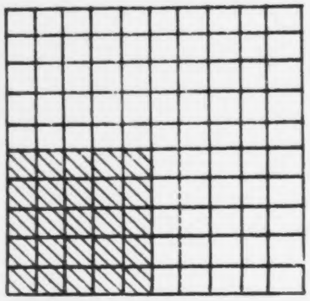
$\frac{50}{100} = 50\%$



$\frac{6}{10} = \frac{60}{100} = 60\%$



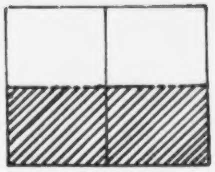
$\frac{2}{5} = \frac{40}{100} = 40\%$



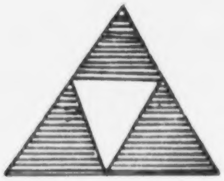
$\frac{1}{4} = \frac{25}{100} = 25\%$

VI-A, 02, 06

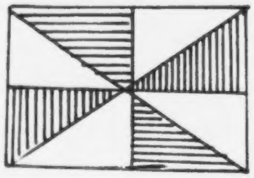
4. Give the students several shapes which have been partially shaded in. Have them write the fraction represented by the shaded area to determine what percent is shaded.



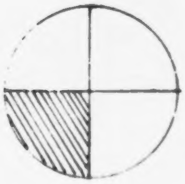
1/2 = 50%



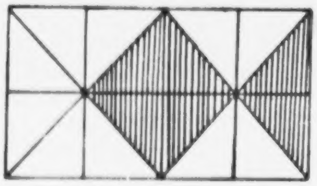
3/4 = 75%



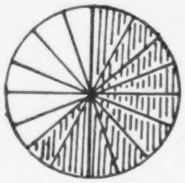
1/2 = 50%



1/4 = 25%



3/8 = 37.5%



10/16 or 5/8 = 62.5%

VI-A, 06

5. Have each student choose a topic such as a hobby, TV watching, or an after-school activity and chart how many hours are spent doing the activity each day of a week. Then they find the total number of hours spent and find what fraction and percent of the week's time this represents (using the total number of hours in a week as the denominator). They may wish to share results with each other.

VI-A, 03, 04, 05, 06, 07

6. Make 15 sets of cards with equivalent decimals, percents, and fractions (e.g., 38%, .38, 19/50). You may choose to include or exclude mixed numbers (percents over 100). Have students play Concentration with the set of cards.

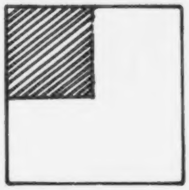
VI-A, 03, 06; V-B, 05

7. Since a dollar is 100 cents, students can use percents to compare a number of cents to 100 cents or to 1 dollar. Have them express amounts of change less than a dollar as a percent of 1 dollar and then as a ratio. For example, 23 cents is 23% of a dollar or 23/100.

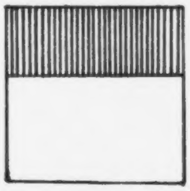
   a. 1 nickel (5% or 5/100)
   b. 1 quarter (25% or 25/100)
   c. 1 quarter , 2 dimes, 1 nickel (50% or 50/100)
   d. 1 quarter, 3 dimes, 4 nickels, 2 pennies (77% or 77/100)

VI-A, 05

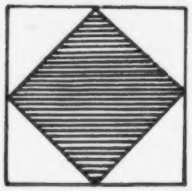
8. Write the percent of the square that is shaded as a fraction in lowest terms.



A. $50\% = \frac{50}{100} = \frac{50 \div 50}{100 \div 50} = \frac{1}{2}$



B. $30\% = \frac{30}{100} = \frac{30 \div 10}{100 \div 10} = \frac{3}{10}$



C. $25\% = \frac{25}{100} = \frac{25 \div 25}{100 \div 25} = \frac{1}{4}$

VI-A, 07

9. Give students place value material or a hundred grid. Remind them that percent means parts per hundred. Demonstrate percents greater than 100.

Example: 5 parts out of 100 or 5/100 = 5% = .05
50 parts out of 100 or 50/100 = 50% = .50
500 parts out of 100 or 5 = 500% = 5.0
5 wholes = 500% = 5.0
5 1/100 = 5 wholes + 1/100 = 501% = 5.01
5 1/2 = 5 wholes + 50/100 = 550% = 5.50

VI. PERCENT, RATIO, AND PROPORTION

B. Calculates rate, base, and percentage.

VI-B, 01

1. Have students take 20% of 100, then 20% of that, then 20% of that, and so on, until their answer is a decimal with four initial zeros to the right of the decimal point. Have them repeat this with 50%, 80%, and 90%. Ask what pattern they see and if they ever get zero as an answer (answers continue to decrease, but will never reach zero). Now have them test 110% to see if it fits the pattern they found (no, answers increase). Ask them to find the smallest percent for which their pattern does not hold (100%).

VI-B, 02

2. Have each of ten students write any 2-digit numeral on a card. Put all the cards in a bag. Have a student draw two cards. All students find what percent the lesser number is of the greater number. Continue with the remaining cards.

VI-B, 02

3. Have students survey the class to determine things students would like to know about each other (e.g., favorite hobbies, TV shows, rock groups, or colors, etc.). Use this information to make a chart listing the items in the left column and the number of students selecting them in the right column. Have students find what percent of the class chose each item surveyed.

VI-B, 03; VI-D, 03

4. Find a newspaper ad which quotes a sale price. Have students find the original price when this sale price is 90% of the original price; 85% of the original price; 77% of the original price; and 66% of the original price.

   This is a good opportunity to explain to students the meaning of "price," "sale price," and "rate of discount." Lead students to understand the reciprocal relationship between "rate of discount" and percent of "price."

VI-B, 04

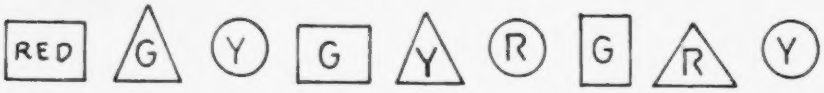
5. Have students record the number of minutes a day they spend on homework for one week. Help them compute the daily percentage increase or decrease.

VI. PERCENT, RATIO, AND PROPORTION

C. Understands ratio and proportion.

VI-C, 01

1. Cut out these shapes from construction paper, or use tangrams, attribute blocks, or pattern blocks.



Display the cut-outs and ask for ratios. For example, you might ask for the ratio of triangles to circles, circles to red triangles, small triangles to green figures.

VI-C, 01

2. Have students bring in articles which use the terms rate or ratio. Use the articles and any accompanying artwork for a bulletin board. Suggestions are population ratios, steering ratio of a car, value of gold or silver, etc.

VI-C.02

3 Introduce proportion in both forms 2/3 = 10/15 and 2 : 3 = 10:15. Explain that both may be read as "2 is to 3 as 10 is to 15." Use the following example to show that the product of means equals the product of extremes. Be sure that students understand "extreme" to mean the numbers on the extreme ends of the statement.

Example: 2 : 3 = 10 : 15
↖means↗
↖ extremes ↗

Show that the product of means equals the product of extremes.

$$\frac{2}{3} = \frac{10}{15} \Rightarrow 2 \times 15 = 3 \times 10$$

$$6 : 7 = 12 : 14 \Rightarrow 6 \times 4 = 7 \times 12$$

$$\frac{3}{5} \neq \frac{7}{10} \Rightarrow 3 \times 10 \neq 7 \times 5$$

$$\frac{a}{b} = \frac{c}{d} \Rightarrow ad = bc$$

VI-C, 03

4. Have students complete the proportions to find the number of drops of food coloring needed to produce the desired color.

Example:	pink:	$\frac{\text{4 white}}{\text{1 red}}$	$\frac{\text{20 white}}{\text{( ) red}}$
	orange:	$\frac{\text{2 yellow}}{\text{5 red}}$	$\frac{\text{( ) yellow}}{\text{15 red}}$
	green:	$\frac{\text{3 yellow}}{\text{4 blue}}$	$\frac{\text{6 yellow}}{\text{( ) blue}}$
	purple:	$\frac{\text{6 blue}}{\text{8 red}}$	$\frac{\text{( ) blue}}{\text{32 red}}$

VI-C, 04

5. Give students a quantity of cubes or squares in two different colors. Have them set up a group and write a proportion.

$\boxed{R}$ $\boxed{R}$ $\boxed{R}$
$\boxed{B}$ $\boxed{B}$ 3 reds for every 2 blues.

Double the number of both reds and blues and write a new proportion.

$\boxed{R}$ $\boxed{R}$ $\boxed{R}$ $\boxed{R}$ $\boxed{R}$ $\boxed{R}$ 6 reds for every 4 blues
$\boxed{B}$ $\boxed{B}$ $\boxed{B}$ $\boxed{B}$

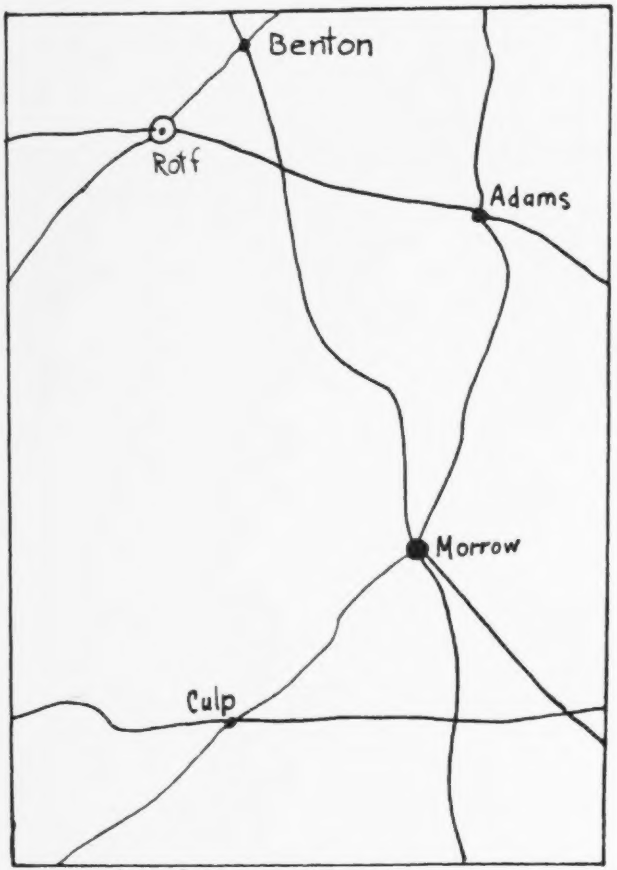
Triple the original number of each color and write another proportion. Write the proportions as fractions 3/2, 6/4, 9/6. Compare fractions and identify the simplest fraction which is the simplest ratio.

Extension. Compare two ratios by cross multiplying.

$$\frac{3}{2} = \frac{6}{4} \quad 3 \times 4 = 2 \times 6$$

VI-C, 05

6. Give students the following map and directions. The scale map tells you that 1 inch on the map represents 10 miles.



Scale · 1 inch = 10 miles

What is the straight-line distance in inches from Benton to Morrow? ________________
Find the missing distance by using the cross-product method.

The four steps of the cross-product method are:

a. $\frac{1}{10} = \frac{3}{X}$

b. $1X = 30$

c. $\frac{1X}{1} = \frac{30}{1}$

d. $X = 30$

What is the straight-line distance from Adams to Morrow? from Benton to Roff? from Culp to Adams?

Add a new imaginary town to the map. Name a town after yourself or your friends. Swap with a neighbor and determine the distance from the other towns to the town you name

VI-C, 05

7. Have students use graph paper to make a scale drawing of a wall in the classroom. They should follow these steps.

   a. Make a rough drawing of the wall.
   b. Measure the length and the width of the wall and any windows, chalkboards, bulletin boards, and doors on the wall. Record these measures on the rough drawing.
   c. Compare the length of the graph paper with the length of the wall. Choose a scale to fit the graph paper. Write the scale at the bottom of the graph paper.
   d. Draw the outline of the wall using the scale chosen. Draw all other objects on the wall in the proper places as measured.

VI-C, 05; VI-E, 02; V-C, 01

8. Distribute Louisiana Road Maps to the students. Have them find the legend. Call attention to the symbols used for interstate, state, and parish highways. Have students use their map to plan a trip from their hometown to a place they want to visit. Have them include the roads they would travel, the total number of miles traveled (using the scale ratio), where they would stop for an evening's rest, and the approximate cost of the trip including gas, food, lodging, and other expenses.

VI. PERCENT, RATIO, AND PROPORTION

D. Understands consumer terms involving percents.

VI-D, 02, 01

1 Have students bring investment or loan advertisements involving interest rates from magazines and newspapers. Discuss which examples represent simple interest and which are compound. Have students compute simple interest for appropriate examples.

VI-D, 02, 01

2. Ask students to pretend that they have $100 deposited in a savings account which earns interest monthly. Have them calculate how much money they would have at the end of one month, if the interest paid them is the current interest rate. Explain that it is not the original $100, but this new sum, that would then earn interest in the following month, etc.; this should clarify the distinction between simple and compound interest.

Extension: Help students to determine how much money they would have at the end of a year (compound interest).

VI-D, 03

3. Discuss price and sale price, discount and rate of discount. Have students collect ads showing discounted items that they would like to buy. Help them find the discount and sale price of each item. Discuss which items are the best buys.

VI-D, 04

4. Have a speaker who works on commission explain how his/her income is determined. Follow-up with discussion on how working on commission differs from working on straight salary. You might also indicate the types of jobs which commonly operate on commission rather than straight salary.

VII. MEASUREMENT

A. Identifies and uses measures of time.

VII-A, 01

1. Have available an assortment of magazines showing many different activities. Work with students to cut and sort the pictures into groups of things that are usually done in the daytime or nighttime; before noon or after noon, etc. Provide worksheets, such as following, and have students paste the pictures in the appropriate column.

☼	☾

VII-A, 02

2. Provide students with a clock face and a paper fastener. From a box containing clock hands of two sizes, ask them to select an hour hand and a minute hand. Each student will label the hands "H" and "M" and attach them to the clock face. They will then set the hands to show given times.

VII-A, 03

3. Present a list of the days of the week (or months of the year) in random order. Have students say the days or months in consecutive order.

Variation:	For students as yet unable to read the words, write the numbers 1 to 7 (or 1 to 12, for months) on the chalkboard. Say each day of the week (or month of the year), one at a time. Ask students to tell you which position the day (or month) holds in the list. Or, point to a number and ask: "What day (month) goes here?"
Variation:	Point to students, one at a time, and say: "You are the first day of the week. What is your name?" Do the same for months of the year. Or, give a day (month) and ask: "Which day (month) comes before or after?"

VII-A, 04

4. Provide students with monthly calendars indicating birthdays, holidays, and other significant dates. They will list events that take place on a specified day of the week. The calendars should show the year. Provide students with cards on which the names of the months and holidays are printed. The students will match the holidays with the appropriate months.

VII-A, 05, 08, 10

5. Use a clock with a sweep hand. Students will name units measured by each hand. Time many activities such as a few hops, writing a word, saying or writing a word or phrase ten times, a given lesson, lunch time, etc.

   Record the time given events began and ended. Have students keep a log of activities and their times. Have students use paper plate clocks and fasten hands to represent selected times, or have them draw hands on printed clock faces.

VII-A, 08, 06, 07

6. At the hour or half hour, ask students to tell the time. Then have them draw pictures to represent what they are doing at that moment. Beside their drawings have them write the time.

VII-A, 09

7. Review counting by fives to 60. Have the class count by fives while pointing to each number on the clock as they count. Emphasize that there are 60 minutes in an hour. After practicing, point to numbers in random order and call on students to tell how many minutes past the hour. Then, have them count by fives and by ones to reach the time named.

VII-A, 10

8. Using a digital and a regular clock, show students that the two clocks show a given time in different ways. Then provide models of clock faces and blank digital clocks. After positioning the hands, students will fill in a blank digital clock with the correct time (and vice versa).

VII-A, 11, VI-B, 02

9 Students will keep a record of the time spent doing such activities as watching TV, eating, talking on the telephone, or doing homework They will then determine the total number of seconds, minutes, and hours spent on the activities for an appropriate period of time

From the data students will determine how many hours or days per month they spend on an activity, converting smaller to larger units as appropriate. They can also calculate how many weeks per year are spent on the activity. Students also should be given practice in reconverting the larger units to smaller ones.

Extension: Students may also be asked to determine the *percent* of time spent.

VII. MEASUREMENT

B. Understands and uses measures of temperature.

VII-B, 04, 03, 01, 02

1 Have students estimate in degrees Celsius the temperature inside and outside the school building. Make the actual measurements and decide if it is hot, cold, or comfortable. Keep a chart of this information and repeat this activity periodically.

Variation: Use Fahrenheit temperatures, or use both and have students keep the chart in columns, one showing each unit of measurement.

VII. MEASUREMENT

C. Understands and uses measures of monetary value.

VII-C, 01, 02, 03, 04, 05, 06, 09, 10

1. Set up a "store" using real items, student-made items, or pictures of items. Label the items with appropriate prices. Tell students that they will get a chance to "go shopping." For each item purchased, students must read the price aloud (e.g., "ten cents") and say the name of the coin needed (e.g., "dime"). Students may use coins or facsimiles to make "purchases." Students could take turns being the store clerk and write a receipt for the purchase showing the value of the purchase with the dollar or cent symbol.

   As a follow-up, allow students to buy several items at a time. They must say the names of the coins needed to make the total purchase, say the value of the total purchase. As students gain practice, expand to values over a dollar and ask students to say how many nickels they would need to make the purchase, how many dimes, how many dimes and quarters, etc.

VII-C, 05, 10

2. Provide students with coins or facsimiles. Obtain some blank price tags, or make some out of tagboard. Have students label each tag with a price less than $1.00 and put them in a container. Have students work in small groups. Taking one price tag at a time from the container, they are to use their coins and count out the amounts shown on the tags.

VII-C, 05, 06, 07, 08; V-D, 01

3. Provide students with coins or facsimiles. Have them show a given amount (limit $1.00) in as many ways as they can. Then have students write the money words and numerical expressions for different amounts. Later, they may do this with amounts larger than $1.00.

VII-C, 09; III-E, 01; II-G, 01, 02

4. Provide students with an assortment of magazines, newspapers, or catalogs that include listings of items with their prices. Ask students to choose several items they would like to buy, round the prices to the appropriate units, tens, or hundreds, and estimate the total cost. Then have them calculate the sums to find out how close their estimates were.

VII-C, 09; VII-G, 01

5. Have students cut ads from the newspaper showing the cost of given item(s). Present problems which require students to perform various operations involving money.

   Example: Given a unit price (e.g., for 1 lb. of apples), calculate the price for multiple units (e.g., 4 lbs.).

   Given an amount of money, determine how many of a given item can be purchased.

   Given the prices of six different items, calculate the total cost.

   Given prices for two different quanitities of the same product (e.g., 12 oz. size and 24 oz. size), calculate the unit price to determine which is the better buy.

VII. MEASUREMENT

D. Understands and uses linear measures.

VII-D, 01

1. Give each student a piece of string. Ask students to find something in the classroom that is longer than their string. (Demonstrate if necessary.) Repeat with finding something shorter than their string.

VII-D, 01

2. Make paper strips of different lengths. Lay them on a table in front of the students. Ask them to identify the longest and the shortest.

   Variation: Use Unifix cubes to make long and short worms.

VII-D, 02

3. Have a small group of students stand in a row facing you. Ask them to start taking giant steps away from or toward you. They continue to take giant steps until you say "stop." Ask who is nearest and who is farthest from you.

   Variation: Play "Red Light." Students line up as for a race. When you say "green light," students walk forward as fast or slow as they like. When you say "red light," all must stop in their place. Repeat several times. Then ask who is nearest or farthest from you.

VII-D, 03

4. Have students use nonstandard units to measure things in the classroom. Discuss their findings. Nonstandard units could include: paper clips, shoes, lengths of string, etc.

   Extension: Ask students: "Which is larger? How many times larger?"

VII-D, 07, 08

5. Organize a metric measure hunt. Supply each student with pieces of string measuring 1 cm, 10 cm, and 100 cm (1 m). Have them find something in the room the size of each string.

   Variation: Use pieces of string measuring 1/2 in., 1 in., 1 ft., 1 yd.

VII-D. 04. 06. 07. 08

6 Mark off enough inches on a paper strip to measure students' heights Attach the strip to the wall Have students work in pairs to measure each other's height and record this information next to their names on a chart

Variation Measure in centimeters

VII-D. 07. 08. 09. 10

7 Provide students with a metric ruler (or some object 1 m long, such as a piece of string). Have students estimate and then use their metric ruler to evaluate their estimates

Example	a	look for several objects in the room that are approximately 1 m in length.
	b	name six objects in the room that are longer than one meter
	c.	tell how many meters long the classroom is

Variation: Provide students with centimeter rulers Have them estimate and measure to verify the length of objects

Variation Use this activity to measure using inches, feet, and yards.

VII-D, 04, 06, 07, 08

8 Have students measure parts of their bodies. Include such things as length of their foot, leg, arm, width of smile, and hand Ask such things as Who has the widest smile, biggest foot, smallest foot, etc ?

VII-D, 12, 10, 09

9. After introducing the units of linear measure, bring in a large trash bag of objects and/or pictures of things to be measured. Have students make a table-top display, classifying the objects into categories according to appropriate unit of measurement.

Examples:

a. Millimeter or fractions of an inch: Since these are used to measure very small things and to measure very precisely, guide students to think in terms of measuring width or thickness of these small objects--paper clip, eraser, crayon, nails, dime, quarter, key, capsule, needle, toothpick, yarn, ring, etc.

b. Centimeters or inches--toothbrush, nail file, book, tablet, spoon, ribbon, chalk, pen, stapler, plaque, etc.

c. Meters or yards/feet--baseball bat, umbrella, fishing rod, rooms, swimming pool, fence, etc.

d. Kilometers and miles--maps or cards stating distances from one location to another.

Students could verify measurements of smaller objects or objects they have at home.

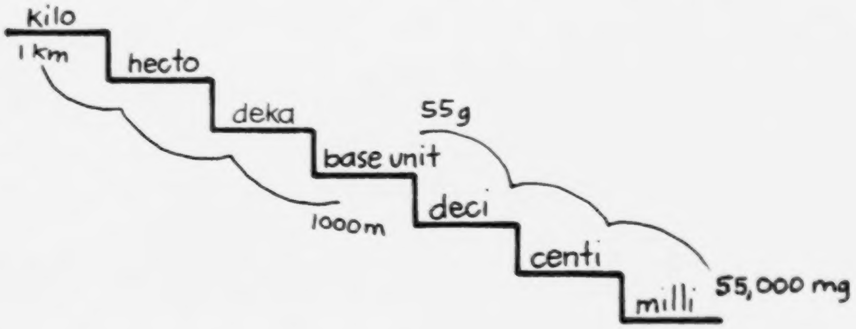
VII-D, 12

10. Students will measure objects such as books, desks, windows, chalkboards, and the classroom in various units of a given system (customary or metric systems). They will record all the measurements for a given item and compare them to determine the unit that offers the most efficient measure.

Students will measure playing areas for different sports and determine appropriate units. Road maps and readings from odometers can be used to extend the concept.

VII-D, 13; VII-E, 07; VII-F, 07

11. Convert measures within the metric system. Use a metric ladder to help students change from one metric unit to another.



To change to a larger unit, go up the ladder and move the decimal point the appropriate number of spaces to the left (e.g., 1000 m = 1.000 km). To change to a smaller unit, go down the ladder and move the decimal point the appropriate number of spaces to the right (e.g., 55 g = 55,000 mg).

VII-D, 13; VII-E, 07; VII-F, 07

12. Prepare a set of cards which will guide students to explore and discover relationships between units of measure. Set aside an area of the classroom where students will have access to a variety of measuring instruments. Make task cards which contain sets of instructions such as the following:

3 feet is the same as ______ inches

2 yards is the same as ______ feet.

18 inches is the same as ______ feet.

150 cm is the same as ______ meters.

VII-D, 08, 13, 15; VII-E, 04, 07, 09,

13. Have students form groups of three or four. Let them weigh each other in kilograms and measure each other in meters. Have them add the weights of the group and give the sum in grams and kilograms. Have them add the heights of the group and give the sum in millimeters, centimeters, and meters. This may be adapted for customary units.

VII-D, 07, 08, 14, 15

14. Place a marker on one of the walls in the classroom dividing the length into parts. Have students measure both of the lengths, write each measurement, and then add the two. Have them check their addition by measuring the entire length of the wall. Change the position of the marker and have students measure again.

VII-D, 07, 08, 14, 15

15. Place a marker on one of the walls in the classroom dividing the length into two parts. Have students measure the length of wall, measure one of the parts, and subtract the part from the entire length. Have them measure the other part to check their subtraction.

VII-D, 07, 08, 14, 15

16. Have students measure the length of another student's foot and then measure the length of the student's big toe. Have them write both measurements and subtract the two. They can check their subtractions by measuring the rest of the foot.

VII. MEASUREMENT

E. Understands and uses measures of weight (mass).

VII-E,01

1. Choose two objects at a time to make comparisons in weight (lighter, heavier).

VII-E,01

2. Place several toys or blocks of different weights on a shelf. Have students arrange these objects from lightest to heaviest.

VII-E,02,03,04,05

3. Provide many activities in which students actually weigh concrete objects. Discuss the reasons for measuring given objects in particular units.

VII-E,02,03

4. Have students circle items in a newspaper advertisement that are sold by the ounce. Ask them to use a different color to circle those items which are sold by the pound.

   Variation: Use metric (SI) measures.

VII-E,04,05

5. Without measuring have students make balls of clay that weigh approximately 1g, 10g, and 100g. Then weigh each ball to determine the actual weight.

   Variation: Use customary measures.

VII-E,04,05,06

6. Put ten items on a table. Have students estimate the weight of each and list them in order from lightest to heaviest. Beside the name of each item on a list, label whether it would be weighed with ounces or pounds. Then label those that would be weighed with grams or kilograms. After all have completed the activity, weigh the objects on appropriate scales to see who was correct.

VII-E, 04, 05, 06

7. Have students collect five objects that they think are less than a kilogram or pound and five that they think are more than a kilogram or pound. Use the balance scale to check their estimates.

VII-E, 08, 09

8. Have students weigh one object and record the weight. Have them weigh a second object, record that weight, and then add the two measurements. As a check, have them weigh both objects at the same time.

VII-E, 08, 09

9. Have students weigh two objects at the same time and record the weight. Ask them to remove one of the objects, weigh the one left on the scale, record the weight, and subtract the two measurements. As a check, have them weigh the remaining object.

VII. MEASUREMENT

F. Understands and uses measures of capacity.

VII-F,01

1. Using a number of containers, have students compare them two at a time for size.

VII-F,02

2. Using liquid measures such as gallon, half-gallon, quart, pint, and cup, ask students to arrange these in order of size, starting with the smallest.

VII-F,02,04

3. Display a number of containers such as a cup, soda bottle, and a pail. Have students guess and then find how much water (sand, rice, etc.) each container will hold, giving their answers in cups, pints, quarts, half gallons, or gallons. If various shaped containers are available, have the students experiment to discover that two containers may have a different shape but the capacity may be the same.

VII-F,04,05,08,09

4. Choose a measuring cup, beaker, or other calibrated container. Have students pour in an amount of water, sand, etc. and record the capacity. Use a second container measuring in the same units, have students pour in a different amount, and record the capacity. Ask them to add the two measurements. As a check, have them pour the two amounts into one larger container.

VII-F,04,05,08,09

5. Have students fill a measurement container and record the capacity. Have them pour out an amount, record the amount remaining, and subtract the measurements. As a check, have them measure the amount poured out.

VII-F,06

6. Display a ones unit and a thousands cube in place value materials. The ones unit would hold 1 milliliter and the thousands cubes would hold 1 liter. Show various containers and ask students whether they would use the milliliter or liter to measure their capacities.

VIII. GEOMETRY

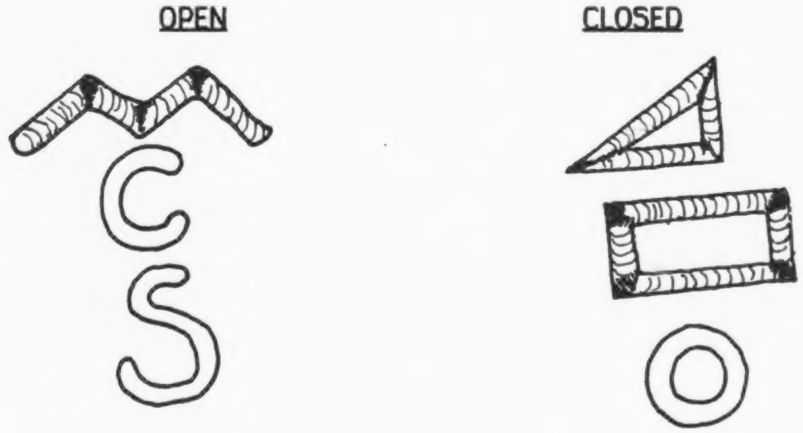
A. Demonstrates a working knowledge of closed plane figures.

VIII-A, 01

1. Have students use yarn to form open and closed figures on the flannelboard. Have them tell whether the figure displayed is open or closed. The student who answers correctly gets to form the next figure.

VIII-A, 01

2. Have students use sticks, straws, or pipe cleaners to construct a variety of closed and open figures. Display these in two groups.



VIII-A, 01

3. Make a circle on the floor. Have the students stand around it. Give directions and ask questions such as the following:
   a. Michael, stand inside the circle.
   b. Where is Michael standing?
   c. Where are we standing?
   d. Now, Michael, stand outside the circle.
   e. Who is standing inside the circle?
   f. John, Jim, Bob, stand inside the circle.
   g. Where is John standing?
   h. Girls, stand inside the circle.
   i. Everyone stand outside the circle.

VIII-A, 01

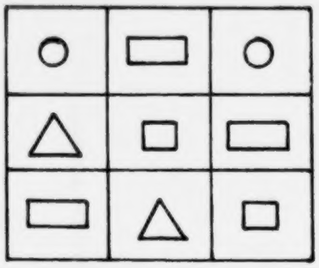
4. Play the game Tossing the Bean Bag. A circle made of rope, yarn, chalk, or a hoop may be used. Students take turns tossing a bean bag into the circle They tell where the bean bag lands: inside, outside, or on the circle. Students should stand a reasonable distance away from the circle.

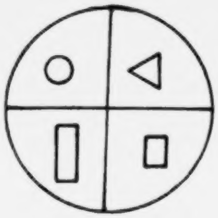
VIII-A, 02

5. Supply students with three Cuisenaire rods with values of 2, 3 and 7. (If rods are not available, make strips of paper with lengths of 2 cm, 3 cm, and 7 cm.) Have other rods (or lengths of paper) available. Ask questions such as, "Can you make a square using the rods you have? Why not? Can you make a triangle? Why not? If allowed to trade one rod, can you make a triangle; a square?"

VIII-A, 02

6 Make simplified bingo cards showing four shapes instead of numbers (some shapes will be represented more than once on each card). A card with a different arrangement of the four shapes should be given to each student. Make a spinner card showing the different shapes. Play bingo. Have students put a marker on their cards over the shape that is shown on the spinner.





VIII-A, 02

7 Give each student a collection of shapes. Hold up a square and tell them to do the same. Repeat with other shapes. You can quickly detect students having difficulty recognizing the characteristics of the shapes.

Next, do not hold up a shape but simply ask students to hold up the correct shape, given its name.

VIII-A, 02

8. Have students look around the room and find objects which have the same shape as a square. Repeat with triangle, circle, and rectangle.

VIII-A, 02, 03

9. Make a set of sturdy cards in the shape of a circle, rectangle, square, and triangle. Ask students to find other things having the same shape. Have the students classify the objects according to shapes.

VIII-A, 02, 04

10. Provide patterns for the shapes. Have students reproduce (not trace) the shapes, and label the circle, square, rectangle, and triangle.

VIII-A, 05

11. Make two sets of cards depicting pictorial representations of the parts of the circle (center, radius, diameter, circumference, semi-circle), two sets of word cards, and an "Old Circle" card. The "Old Circle" could be a circle drawn with facial features and a beard. The game is played like Old Maid, matching word cards with picture cards. The player who is left with the Old Circle card in his/her hand is the loser.

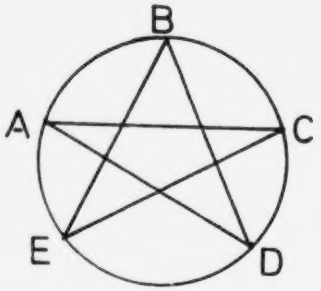
VIII-A, 05

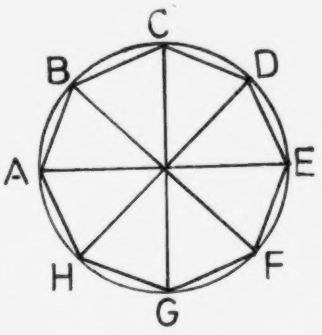
12. Have students use circle geoboards and colored rubber bands to show the parts of a circle: radius, diameter, circumference, semi-circle.

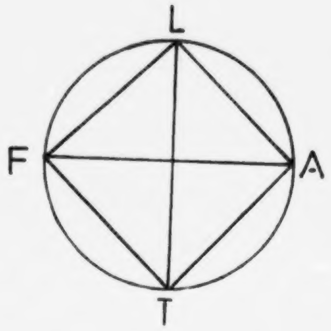
VIII-A, 06

13. Using compass and straightedge have students make designs of their choice and name chords and arcs.

Example:





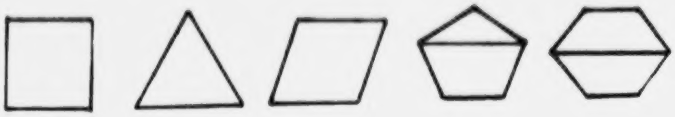


VIII-A, 06

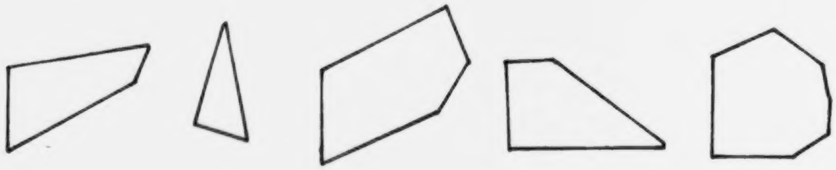
14. Have students show chords and arcs on a geoboard or have them draw these parts of a circle on dot paper.

VIII-A, 07; VIII-C, 02, 03

15. Stress that a polygon is regular if all of its sides are congruent segments. Demonstrate. Have students find the perimeter of regular polygons by measurement and develop the formula (number of sides times length of one side).



Regular



Not regular

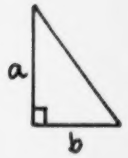
VIII-A, 09, 08

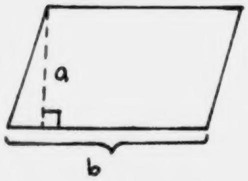
16. Draw the picture

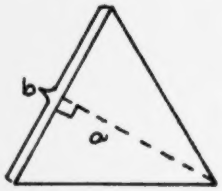
POLYGON	DESCRIPTION	PICTURE
Quadrilateral	Any polygon with four sides.	
Parallelogram	Opposite sides are congruent. Opposite angles are congruent.	
Rectangle	Opposite sides have the same length. All angles are right angles.	
Square	All sides have the same length. All angles are right angles.	
Rhombus	All four sides have the same length.	
Pentagon	Any polygon with five sides.	
Hexagon	Any polygon with six sides.	
Octagon	Any polygon with eight sides.	

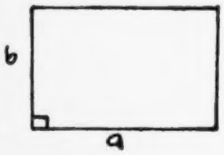
VIII-A, 10

17. Emphasize that base and altitude of any figure are always perpendicular to each other.





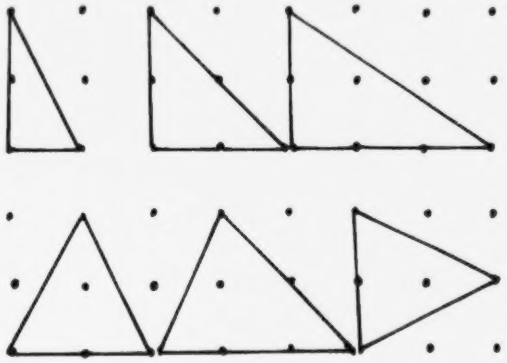




Use dot paper to draw and demonstrate, turning the same triangle to different positions to show the possibility of several pairs of "base and altitude" for the same figure. Do the same with a parallelogram.

VIII-A, 10

18. Use dot paper. Ask students to draw different triangles all of which have a height of 2.



VIII-A, 12, 11

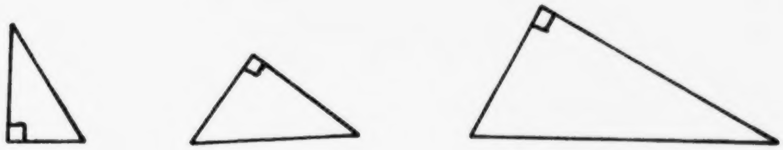
19. Ask students if the following are acceptable classifications for triangles. If so, draw an example; if not, why not?

a. right obtuse
b. scalene isosceles
c. obtuse equilateral
d. acute equilateral
e. isosceles acute
f. equiangular scalene

VIII-A, 13

20. Use geoboards or dot paper to demonstrate different shapes of right triangles. Have students identify legs and hypotenuse.

Example:



VIII-A, 14

21. Distribute tracing paper and graph paper to each student. Have students carefully fold the graph paper twice so that there are four equal parts. (Do the same with the tracing paper.) Have students choose and draw a simple geometric shape in one of the four parts of their graph paper. Next, they are to trace that shape in the corresponding section of the tracing paper. Explain that the two figures are congruent because they are the same size and the same shape.

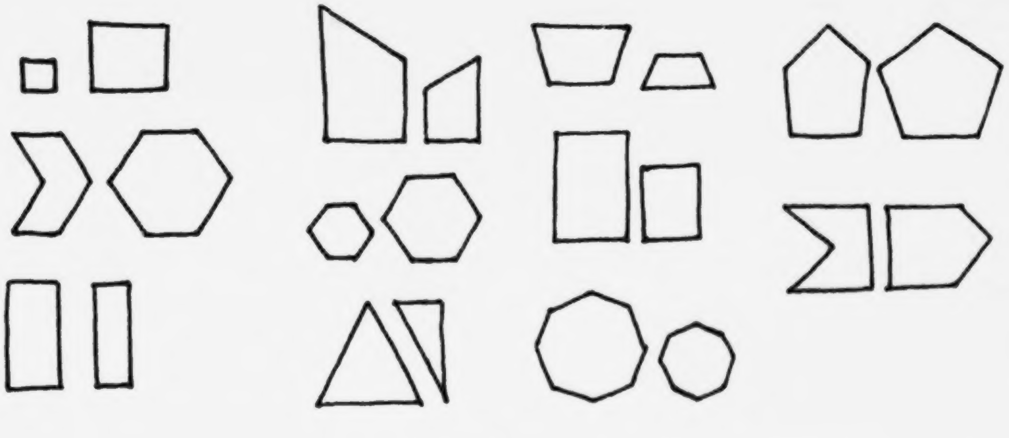
    Continue the activity having students fill the remaining three sections of each sheet with matching figures.

VIII-A, 14

22. In a box put multiple copies of various figures. Have students select several figures and determine which of these are congruent and which are similar.

VIII-A, 14

23. Cut out several pairs of figures. Have students work together to discover which pairs are similar and which pairs are not. Sample pairs are shown below:



VIII. GEOMETRY

B. Demonstrates a working knowledge of points, lines, and angles.

VIII-B, 01

1. Each student is given paper and scissors. They are given a choice of folding their paper once or twice, and then they cut out a shape with the fold included. Have students unfold their papers, identify the type of symmetry represented, and place the papers on a bulletin board for display.

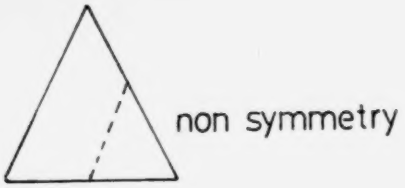
VIII-B, 01, 05

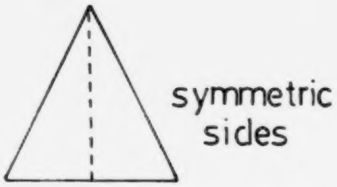
2. Use large paper cut-outs of block alphabet letters. Fold some to show symmetry. Have students determine symmetry for the rest by folding.

   Extension: Have students categorize letters according to those that contain horizontal lines, vertical lines, or both.

VIII-B, 01

3. Prepare large cut-outs of plain figures (shapes: triangle, rectangle, circle, etc.). Fold on several different lines to show nonsymmetry. Then, show correct line(s) of symmetry.





VIII-B, 01

4. Give each student a cut-out of a large regular hexagon shape. Ask them to discover by folding how many lines of symmetry there are.

VIII-B, 02

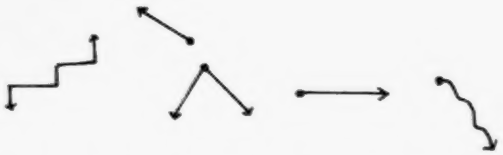
5. Use real life examples to represent points, lines, line segment, and rays.

Example: A line could be shown by a student standing with both arms stretched out and hands open. For a line segment, the student would close his/her hands. For a ray, the child would stand with one arm stretched out overhead with the hand open and the other arm flat against the body. For a point the student would hold both arms to the chest, hands closed and clasped.

Example: A road extending as far as you can see in both directions would represent a line. A road extending only in one direction would represent a ray. A section of the road would represent a segment and a house on the road would be a point.

VIII-B, 02

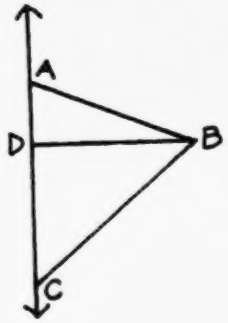
6. Draw different rays on the board. Have the rays point in all directions. Put other drawings on the board that are not rays.

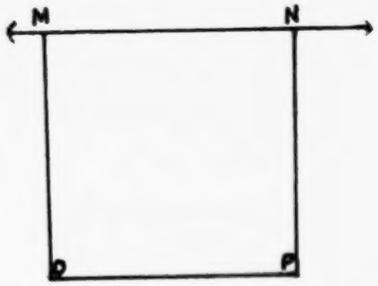


Ask which are rays and why are they rays. Which are not rays and why not?

VIII-B, 02, 07

7. Give students shapes such as the following. Have them list the points, lines, line segments, rays, and angles.





VIII-B, 03

8. Use a large picture or drawing of one face of a rectangular building with many rows or columns of windows. Starting from the door at the lower left corner, have students find the correct window from instructions such as: Find the window that is to the right six windows and up two windows.

Variation: A rectangular pegboard may be used for this activity.

VIII-B, 04, 05, 06

9. Introduce the concept of parallel and perpendicular lines using sticks or drawings on the chalkboard.

As a follow-up, have students find examples of parallel and perpendicular lines in the classroom and school grounds. You might also show a map of your city or town; have students name pairs of streets that are parallel and perpendicular.

Variation: Use the same activity to illustrate horizontal and vertical lines.

VIII-B, 04, 06

10. Have students find pictures that represent parallel and perpendicular lines. Create a bulletin board display.

VIII-B, 04, 06

11. Lead students to discover examples of parallel and perpendicular planes in the classroom. Divide the class into teams. Have each team list as many examples as they can and share the examples they have listed.

VIII-B, 07

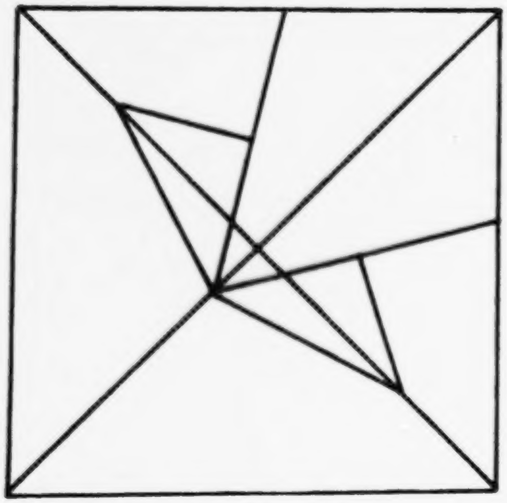
12. Have students make a right angle tester. They should fold a piece of paper, then fold it again, matching the folded edges. The folded corner is the right angle tester. Have them measure angles on objects around the room to test for right angles. After they have worked with objects, they should be ready to test for right angles on a worksheet.

VIII-B, 07

13. Have students point out areas of the classroom that form angles. Have them point out the sides and the vertices of the angles. They may also use their fingers to show angles.

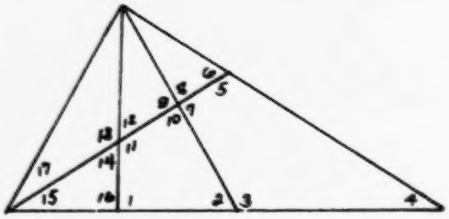
VIII-B, 07

14. Give students a geometric design such as the following. Have them find and label all the angles (vertex and sides).



VIII-B, 08

15. Have students use this figure to identify acute, obtuse, and right angles.



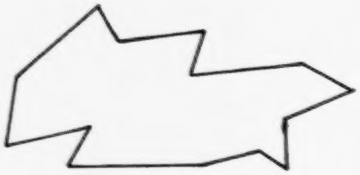
Answers: Acute 15, 12, 14, 4, 6, 2, 17
Obtuse 13, 11, 5, 3
Right 1, 16, 7, 8, 9, 10

VIII-B, 08

16. Use tangrams to construct figures and identify angles.

VIII-B, 08

17. Have students draw an irregular figure and find the number of right, obtuse, and acute angles in it.

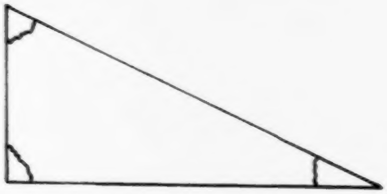


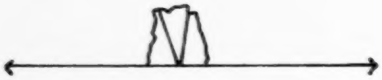
VIII-B, 08, 09

18. Draw a clock. The two hands of the clock suggest an angle. Ask students:
    a. What kind of angle is formed at 3 o'clock? (right angle)
    b. What time would form an angle congruent to 3 o'clock? (9 o'clock)

VIII-B, 10

19. Have students draw and cut out five triangles. They carefully tear off the three vertices of one triangle and paste them on a line drawn on another sheet of paper to discover that the measures of the angles of a triangle sum to 180°. Repeat with other triangles.





VIII-B, 10; VIII-E, 02

20. Write the measures of the angles of five triangles on 15 separate cards and shuffle. Have students group the angles to form five triangles.

VIII-B, 10, 11

21. Have students draw three triangles. Measure the three angles of each triangle. Find the sum of the angles of each triangle.

VIII-B, 11

22. Have the students use their protractors to measure angles on the windows, door, floor tiles, desks, and other objects in the classroom. Discuss which angle is most commonly found.

VIII-B, 11, 12

23. Have students draw a line with a straightedge. Using a protractor, they find its measure (180^{0}). Then have them construct angles of 36^{0}, 144^{0}, 50^{0}, 130^{0}, 55^{0}, 125^{0}, 80^{0}, and 100^{0} in random order. They should draw the pairs of angles that fit together along a line.

VIII-B, 11

24. Have students draw two intersecting lines. Then they will find the measures of the angles using a protractor, record their measures, and add them. Repeat the complete process until students discover that there are 360^{0} around a point.

VIII. GEOMETRY

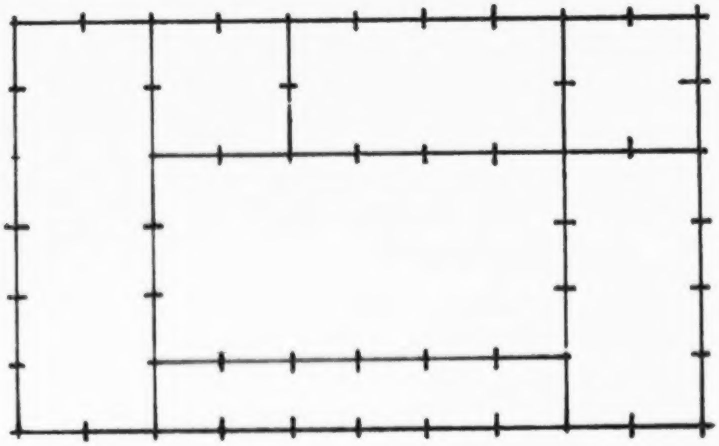
C. Determines perimeter and area of plane figures.

VIII-C, 01

1. Introduce the concept of perimeter by discussing situations in which one might be interested in knowing the distance around a shape (e.g., building a fence or a dog pen, making a path around a building, sewing fringe around a rectangular tablecloth). Then have students identify models of appropriate shapes found in the classroom and compute the perimeter by measuring and adding up the length of each side.

VIII-C, 01

2. Using a worksheet similar to the one below, have students:
   a. Find a rectangle that has a perimeter of 14. Color it green.
   b. Find a rectangle that has a perimeter of 16. Color it red.
   c. Find a rectangle that has a perimeter of 8. Color it yellow.
   d. Find a rectangle that has a perimeter of 12. Color it blue.



VIII-C, 01

3. Given a measurement of a perimeter (e.g.,16 units), have students cut out as many shapes as possible from graph paper with the given perimeter.

   Variation: Have students use dot paper to draw horizontal or vertical figures and determine their perimeters.

VIII-C, 03

4. Have students find perimeters of irregular polygons. Pass out cutouts of irregular polygons and have students measure sides to find perimeters.

VIII-C, 03; VIII-A, 07

5. Have students bring in pictures of road signs and determine whether they are regular or not. Measure to determine perimeters.

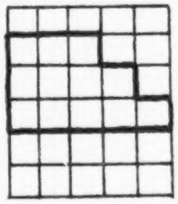
VIII-C, 04

6. Using grid paper, have students color squares with areas 4, 9, 16, 25, 36.

VIII-C, 04

7. Give students a sheet of graph paper on which several shapes have been drawn. Have students find the area of each shape by counting the blocks contained in each shape.

   Example:



   Variation: Give measures of the sides of a given shape (e.g., rectangle: 3" by 4"). Have students measure and draw the shapes on graph paper; then count the blocks enclosed.

   Variation: If geoboards and rubber bands in different colors are available, use them instead of graph paper to show the different figures.

VIII-C, 05, 06

8. Tape paper models of a square inch and a square foot on the board. Have students measure the paper models to determine that all the sides of the square inch are 1 inch in length and that all the sides of the square foot are 1 foot in length.

   Extension: Same activity may be used with square centimeter and square meter.

VIII-C, 08, 09

9. Provide figures of different shapes, some with the same perimeter. Compare the area of figures with the same perimeter.

VIII-C, 09

10. Have students create triangles of different sizes on centimeter graph paper. By counting the squares, students estimate the area of the triangles. Then they use the formula $A = 1/2\ bh$, to confirm their answers.

VIII-C, 09

11. Have students use centimeter graph paper to construct the triangles below. Then they use the formula $A = 1/2\ bh$ to find the area of each triangle.

a. $b = 4$ cm $(2\ \text{cm}^2)$
$h = 1$ cm

b. $b = 10$ cm $(45\ \text{cm}^2)$
$h = 9$

c. $b = 2$ cm $(3\ \text{cm}^2)$
$h = 3$ cm

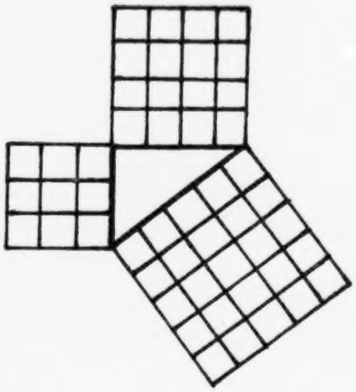
d. $b = 8$ cm $(28\ \text{cm}^2)$
$h = 7$ cm

e. $b = 3.6$ cm $(5.22\ \text{cm}^2)$
$h = 2.9$

f. $b = 4.3\ (6.02\ \text{cm}^2)$
$h = 2.8$ cm

VIII-C, 10

12. On graph paper have students make figures like the one below for a 3, 4, 5 triangle, a 5, 12, 13 triangle, and a 9, 12, 15 triangle. Have students count off the square of the legs and of the hypotenuse to see if $\text{leg}^2 + \text{leg}^2 = \text{hypotenuse}^2$

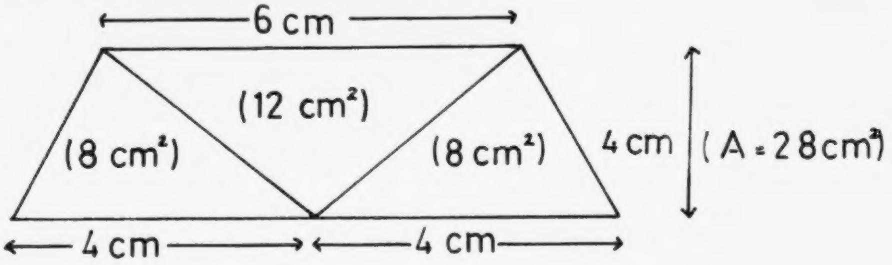


VIII-C, 11

13. Have students use centimeter graph paper to create different parallelograms with areas of 10, 15, 18, 20, 22, and 24 square centimeters. They may use the formula A = bh to confirm their findings.

VIII-C, 12

14. Draw the figure below. Have students find the area of the trapezoid. Then they find the area of each figure inside the trapezoid. They add to find the total area of all figures inside the trapezoid.



VIII-C, 13

15. Ask students to contact a local pizza parlor and find out the prices and diameters of pizzas of various sizes. Then have them find the area of each pizza and how much that pizza costs per square unit of area to determine which pizza is the best buy. Spread the word!

Extension: As part of a social studies unit, have students give a pizza party. Taste test various pizzas. Discuss in class the fact that quality must be considered to determine "best buy."

VIII-C, 13

16. Ask students to find objects in the classroom that have circular regions, such as paper cup, paint bottle, cans. Then have them trace around the objects on graph paper and estimate their areas by counting squares. Afterwards, they can measure the diameter or find the radius and apply the formula to find the area of each region.

VIII-C, 13; VIII-E, 02

17. Have students determine the circumference of a bicycle wheel.

Extension: Have students determine how many complete evolutions the wheel would turn if the bicyle travelled 100 feet, one mile, etc.

VIII-C, 14

18. Supply students with some cylinders (e.g., cans, hatboxes, mugs, glasses, etc.). Have students measure the diameter of each cylinder and then measure the circumference. To measure the circumference, they could wrap a string around the can, mark the string, and the measure the distance between the two marks. Have them keep a record of their findings. Then have them divide the circumference by the diameter and discuss that it is a little more than three times the diameter; this relationship is expressed as π.

VIII-C, 15

19. Using graph paper draw off a 12" x 12" square. Have students determine how many square inches equals one square foot. Do the same for square centimeters and square meters.

VIII. GEOMETRY

D. Recognizes and measures spatial figures.

VIII-D, 01

1. Have students bring things of different shapes from home, such as boxes, cans, ice cream cones, balls, blocks, etc. Have them compare the shapes to a bulletin board with pictures of spheres, cones, rectangular solids, cubes, pyramids, etc.

VIII-D, 01

2. Provide students with several spheres, rectangular solids, cylinders, and cones. Ask how the shapes are alike and different? Encourage students to distinguish between "curved" (or rounded) surfaces and "flat" ones. Ask, "Which rectangular solid or cylinder do you think holds the most?" "Which would hold the least?" Use sand, popcorn, or other material to verify responses.

VIII-D, 01

3. Show objects or pictures of objects in the shape of cubes, cylinders, cones, and pyramids. Include in the display some items that do not belong in any of the categories. Have students sort the objects or pictures and match them with each shape. Have students find examples of these shapes around the school.

VIII-D, 01; VIII-E, 02

4. Play a game "What's This Shape?" Place models of objects in a box. Have a student select an object without letting anyone see it. Other students try to guess the object by asking questions (e.g., "Is it round?" "Does it have four sides?" "Is it less than 8" high?"). The student with the object can answer only yes or no. The student who guesses correctly may make the next selection and the game continues.

VIII-D 02, 03; VIII-E, 02

5. Use metric blocks to build cubes and rectangular solids and then count blocks to determine volume. Repeat. Have students develop the formula for volume by discovery.

VIII-D, 02

6. Have students work in pairs with sets of counting blocks. One student makes a shape with the blocks; the other tells how many cubic units it contains. Explain that the amount of space in a shape is its volume and that the volume of a shape is found by determining how many cubic units will fit inside it. Have students do several illustrations using the blocks.

VIII-D, 04

7. Have students bring boxes, food cans, etc., to class and find the volume of each.

VIII. GEOMETRY

E. Solves problems involving geometry.

VIII-E, 01

1. Have students find the area of the classroom; then have them find how much it would cost to carpet the classroom with wall-to-wall carpeting.

   Example: Carpeting for the classroom costs $12.99 per square yard. What will it cost to carpet the room?

VIII-E, 02

2. Provide students with a catalog that gives the cost of fencing. Have students measure the school yard and determine the cost to completely fence it in. They must include the correct number of posts and at least two gates.

IX. GRAPHS, PROBABILITY, AND STATISTICS

A. Constructs and interprets graphs.

IX-A, 01, 02

1. Help students to make a graph with concrete objects (e.g., footwear). Students answer questions about their own footwear to develop categories for the graph, such as:
    a. Are you wearing shoes or boots?
    b. Are the soles of your shoes smooth or bumpy?
    c. Do your shoes have laces, buckles, or are they plain?

    Other suggestions for graphs include:
    a. people with eyes of different colors
    b. favorite fruits - apple, orange, banana
    c. scary or friendly masks for Halloween

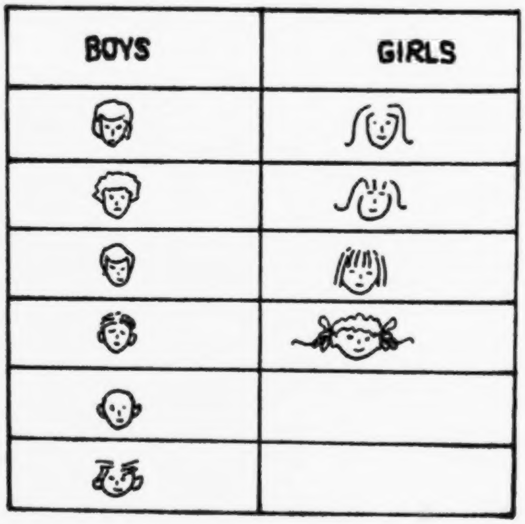
    Ask questions to encourage interpretation of graphs.

    Extension: Use to make pictograph.

IX-A, 02, 03

2. Distribute small squares to students; have each student draw a picture of him/herself on the square. Collect the pictures and make a pictograph showing the number of boys and girls in the class.

Example:



See next page . . .

Use the graph developed to introduce the idea of pictographs. Pictographs help us compare groups by using pictures of the real object. Ask questions to assist students in interpreting the graph:

a. What is being compared?
b. Which group has more? less?
c. How does the pictograph help you compare things?

IX-A, 02, 03

3. As a group, construct a chart to illustrate how students came to school. Use this information to construct a pictograph.

Example:

Did you walk or ride to school today?													
Walk													
Ride													

Have each student draw feet or a wheel to illustrate whether s/he walked or rode. Ask questions to assist in interpreting graphs.

IX-A, 02, 04

4. Have students collect data to make a pictograph, circle graph, or bar graph. Have groups of students develop an organized method for collecting the data (personal interviews, questionnaires, etc.), decide on a format for presenting it, and formulate questions to assist other students in interpreting it.

Some topics are:
a. favorite brands of toothpaste, soap, etc.
b. kinds of pets
c. favorite TV shows
d. number of siblings among classmates

IX-A, 04, 03

5. Have students list the twelve months of the year across the bottom of a sheet of paper to begin creating a simple bar graph. Have them find out from all students in the class the month of their birthdays and graph this information. Discuss the data on the completed graph, asking students such questions as: "What month has the most birthdays?"; "How many more birthdays are in June than in November?"

   Variation: Use this same activity to develop a simple chart and ask similar questions requiring interpretation of the information.

IX-A, 03, 04, 02

6. Display a large calendar for the month. Each day have students record whether the weather is sunny, rainy or cloudy. At the end of the month, elicit from students the number of sunny days, rainy days, and cloudy days. Construct an appropriate chart, pictograph, or bar graph. Ask questions which will require students to interpret the data they have collected.

IX-A, 04, 05

7. Ask students to make a budget to show how they would use their weekly or monthly allowance (for younger students) or any money they might earn (for older students). Then they should make a circle graph to display this information.

IX-A, 03, 05, 06

8. Have students look for bar graphs, circle graphs, line graphs, and complex pictographs in the newspaper and national news magazines; and cut them out. Formulate and ask questions to use in data interpretation.

   Keep a list of topics represented by these graphs, and ask students to determine and make the appropriate type of graph to show the number and variety of topics represented (e.g., unemployment, population, budgets, voting patterns).

IX-A, 06; IX-C, 02

9 Guide students to understand the types of data that are appropriate for bar graphs as opposed to line graphs Discuss the concept of discrete vs continuous data. Ask students to give examples of discrete variables--ones easily represented by categories. Examples. sex (boys and girls), pets (dogs, cats, birds, fish, etc.), weather (sunny, cloudy, rainy). Ask students to supply other examples of discrete variables

Next, give examples of continuous variables--ones whose values can be represented on a number line--and reasons for graphing these variables Examples: temperature (changes); population sizes (growth/decline), amounts of money (income or profits across time, etc.). Have students generate other examples of continuous variables

You might wish to discuss circle graphs as appropriate for variables that can be represented as a whole (100% of something)--with data given in percents. Give some examples: a given amount of money (budget categories); a given period of time (activities performed), a finite population (subpopulations, such as types of jobs held, age, ethnic groups). Ask students to try to formulate other examples of variables and categories. Discuss the distinction between bar graphs which define the graphed categories in terms of quantity (on the vertical axis) and circle graphs (which define graphed categories in terms of percentages of the whole).

IX. GRAPHS, PROBABILITY, AND STATISTICS

B. Uses probability and statistics.

IX-B, 01

1. Have students look through the sports section of the newspaper and find the wins and losses for their favorite teams in a given sport. Then have them find the average score for all the teams.

IX-B, 01

2. Have students use reference books such as almanacs, encyclopedias, or record books to find information such as heights of buildings, lengths of rivers or bridges, stadium capacities, etc. Then have them find the average heights, lengths, etc., of the information they find.

IX-B, 01

3. Share a list.of numerical grades that students have made on previous quizzes (numbering rather than naming the students). Have students find the average of their own personal grades.

   Variation: Have students assign values 4 through 1 to grades A through D, respectively. Have them calculate their grade point average.

IX-B, 02; IX-C, 02

4. Have students collect the daily temperatures from the paper for a month. They will then find the mean, median, mode, and range. Discuss the differences between the measures of central tendency (i.e., mean, median, and mode).

   Variation: During the term have them record basketball scores for all games played by their favorite team; and find the mean, median, mode, and range.

   Extension: Ask students to speculate on the effect on the mean, median, mode of changing one or more values in the distribution (e.g., changing a score that is near the middle to one that is near an extreme).

IX-B, 03

5. Have students flip one penny and determine the number of possible outcomes. They should record this in a chart, as shown below, and continue developing the chart as the activity progresses. Next toss 2 pennies and find the probability of 2 heads, 1 head and 1 tail, or 2 tails. Continue with three pennies. Find the probability of 3 heads, 2 heads and 1 tail, 1 head and 2 tails, or 3 tails.

1 Penny
H
T

2 Pennies
HH
HT
TH
TT

3 Pennies
HHH
HHT
HTH
HTT
THH
THT
TTH
TTT

IX-B, 03; IX-C, 02

6. Play "ESP and Probability." Develop a set of 40 cards containing the following four symbols (ten each):

□ Δ Ø ≋

Have a pair of students work together. One partner shuffles the cards and turns the deck face down; then tries to guess the top card. The student turns over the top card and notes on the chart (see below) whether the guess was correct or incorrect; s/he does this for 20 tries.

	Right	Wrong		Right	Wrong
1.			11.		
2.			12.		
3.			13.		
4.			14.		
5.			15.		
6.			16.		
7			17.		
8.			18.		
9			19.		
10			20.		

Total Right: ______

Ask the student how many times s/he guessed the correct symbol. Then ask his/her partner these questions

a. Do you think your partner has ESP? Why or why not?

b. If your partner is just guessing, what is the probability of his/her guessing correctly on any one trial?

c. If s/he tried 100 times, about how many guesses would be correct?

IX-B, 03; IX-C, 02

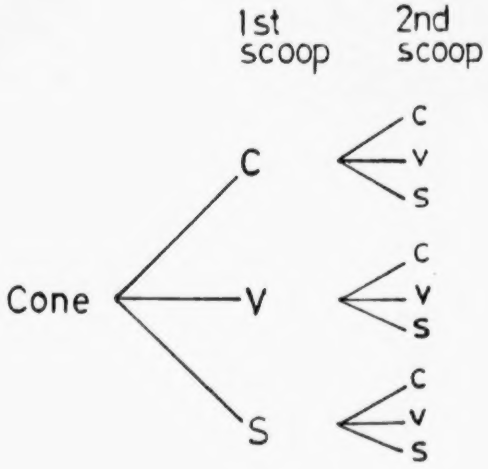
7. Have students answer the following questions using the Bingo card below.

   a. What is the probability of calling a prime number?
   b. What is the probability of calling a number from column N?
   c. What is the probability of calling a number between 4 and 8?
   d. What is the probability of calling an even number?

B	I	N	G	O
6	27	38	52	66
9	25	40	53	69
8	22	FREE SPACE	51	68
10	23	36	57	70
4	21	39	55	64

IX-B, 04; IX-C, 02

8. Have students draw diagrams for choices in their everyday lives. For example: If the choices of flavors are chocolate, strawberry, and vanilla, how many choices would they have if they wanted 2 scoops.



IX-B, 04

9. Invite a speaker to address the class on applications of probability theory in given areas of expertise.

Examples:
- a. a speaker from a local TV station to explain how the probability of rainfall is predicted
- b. a speaker from an insurance company to explain how life expectancy tables are developed to determine premium rates for life insurance policies
- c. a university professor to explain how odds are calculated in game theory

X. PRE-ALGEBRA

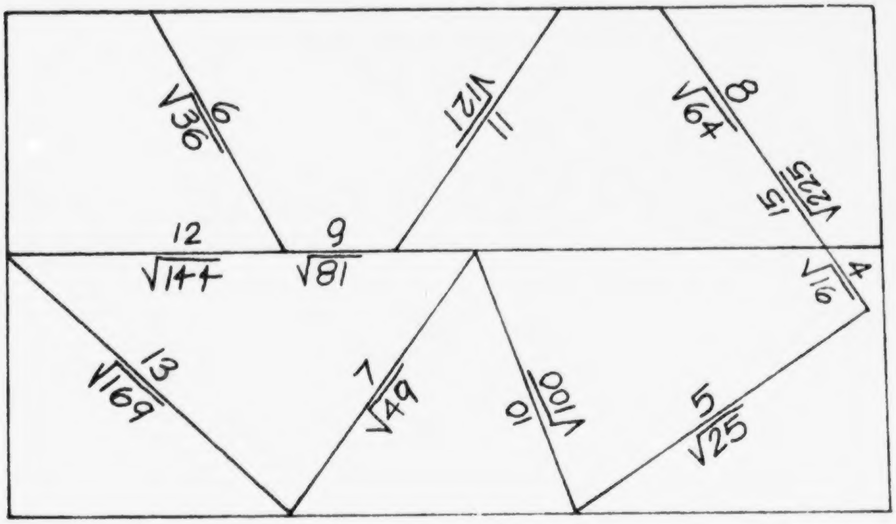
A. Finds squares and square roots.

X-A, 01

1. Give students grid paper. Have them shade in a 1 x 1 square and ask how many blocks are shaded in. Write this as $1 \times 1 = 1^2 = 1$ Have them shade in a 2 x 2 square and ask how many blocks are shaded Write $2 \times 2 = 2^2 = 4$ Ask them to guess how many blocks would be shaded in for a 3 x 3 square or 3^2. Some will guess 6 or 8. Have them shade in the 3 x 3 square. Ask them to guess about 4^2 and so on. Explain that square numbers can be represented by two-dimensional figures and that their length and width are equal (i.e., they form a square).

X-A, 02

2. On a piece of cardboard write several square root equations. Cut the cardboard into puzzle pieces. Have students put the puzzle together so that the correct solution for each equation shows



X. PRE-ALGEBRA
B. Uses exponents.

X-B, 01, 02

1. Have students do a paper folding exercise with exponents. Fold a piece of paper in half once. Ask how many parts they have? ($2^1 = 2$). Fold it in half one more time, for a total of two folds, and see how many parts they have ($2^2 = 4$). Fold it in half yet again (three folds, or $2^3 = 8$). Have them fold another sheet of paper into thirds, writing the exponential form each time (first fold: $3^1 = 3$; second fold: $3^2 = 9$).

   To explain the 0 power simply say that you are too lazy to fold a piece of paper even once, so you have 0 folds, and only one part ($2^0 = 1$).

   Extension: This can be extended to bases of 10. It is easier simply to show a grid broken into 10 pieces, and then into 100 pieces.

X-B, 03, 04

2. Have students use a meter stick to measure various objects in the room. These measurements can be recorded in scientific notation in meters, centimeters, and millimeters. Then ask students to rewrite the measurements in standard notation.

X-B, 03

3. Have students use reference books to find out the distances of all the planets from the sun. Have the students write the distances in scientific notation using exponents.

   Variation: Have students use a calculator to divide the distance from the earth to the sun by the distance from the earth to the moon to determine how much farther the sun is than the moon. Students should enter the distances in scientific notation.

X-B, 04

4. Have students use a calculator or computer which returns results of calculations in scientific notation. Ask students to perform given calculations and interpret each result.

X. PRE-ALGEBRA

C. Identifies and uses integers and rational numbers.

X-C, 01

1 Have students list as many real-world situations as they can in which integers are used.

Examples:

- a. Find money, lose money
- b. Hours from now, hours ago
- c. Gain pounds, lose pounds
- d. Degrees above zero, degrees below zero

X-C, 01, 03

2 Have students identify examples of number lines in everyday use and discuss them. Some examples are a ruler, a thermometer, and an elevator. Have students show on a number line such things as:

- a. a gain of five pounds
- b. a loss of 2 inches
- c. a price decrease of ten cents
- d. a temperature of 16^0 C above zero
- e. a valley 8 yards below sea level

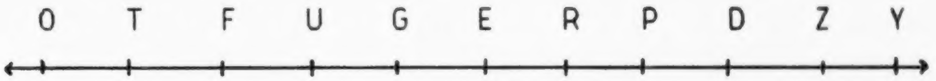
X-C, 01, 02, 03, 05

3 Demonstrate negative and positive numbers on a Farenheit thermometer. Ask students to indicate whether given readings are positive or negative (e.g., 32 dgrees above zero). Then, have students write the notation that stands for given temperatures (e.g., 10 degrees below zero; 70 degrees above zero). Discuss the relationship of the additive inverses relative to zero degrees.

Variation: Use a Centigrade thermometer for this activity. Then compare the thermometers and discuss as two different number lines.

X-C, 01

4. Have students complete the chart using the line to spell out the message.



START	GO	END
T	+3	
G	-4	
P	-7	
F	+6	

START	GO	END
O	+2	
Y	-10	
U	+3	

START	GO	END
E	+5	
R	-6	
D	-5	

(The answer spells: GOOD FOR YOU)

X-C, 02, 03, 06, 05, 09

5. Post a large segment of a number line. Assign students various whole numbers and have them physically position themselves at the matching position on the line. Students can note:
   a. location of negative numbers vs. positive numbers;
   b. the absolute value is the number of units from zero;
   c. that additive inverses are located equidistant from zero

Variation: Use the number line and assign students rational numbers to be located on the number line (e.g., +2 1/2, -5.25).

X-C, 03

6. Have students type the following commands into a computer.

```
PRINT INT (3.4)
PRINT INT (-3.4)
PRINT INT (3.9)
PRINT INT (-3.9)
```

The computer results can be posted on a number line. The function INT in BASIC should return the largest integer less than the number in brackets.

X-C, 04

7. On each of 15 cards write any positive integer between +1 and +20. On 15 other cards, write any negative integer between -1 and -20. Shuffle and deal out all the cards face down to a group of three students. Each student then turns over his/her top card. The player with the greatest number keeps all the cards played that round. Repeat until all cards are played. The student with the most cards is the winner.

X-C, 07

8. Have students find the missing numbers in the magic square (the ones shown in circles should be left blank on student copies). Then have students add +5 to each number of the square and determine if the result is a magic square. Have students add -4 to each number and determine if the result is a magic square.

+4	-10	-9	+1
-7	-1	-2	-4
-3	-5	-6	0
-8	+2	+3	-11

X-C, 07, 08

9. Have students perform the following calculations and use the code below to fill in the blanks which follow. The answers will spell "Solar Power."

A	E	L	O	P	R	S	W
1.5	-5.5	5.5	11.2	-13	3	-4	4

1. -5.5 - (-1.5) =
2. +13 1/5 - (+2) =
3. +3.8 - (-1.7) =
4. +5 1/8 - (+6 5/8) =
5. 0 - (-3) =
6. -8 - (+5) =
7. -20.4 + (+31.6) =
8. -1/2 - (-4 1/2) =
9. -2.1 - (+3.4) =
10. +4 1/3 - (+1 1/3) =

S	O	L	A	R	P	O	W	E	R
1	2	3	4	5	6	7	8	9	10

X-C, 07

10. Review the following display. Ask students to see if there is a pattern established by the table.

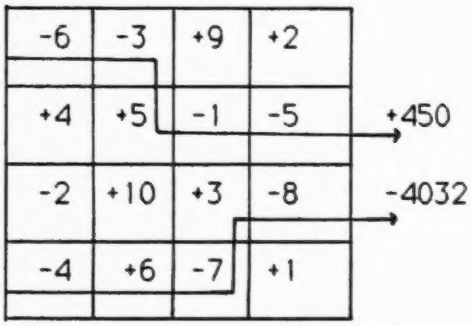
+6 x +3 = +18
+6 x +2 = +12
+6 x +1 = +6
+6 x 0 = 0
+6 x -1 = -6

-5 x +3 = -15
-5 x +2 = -10
-5 x +1 = -5
-5 x 0 = 0
-5 x -1 = +5

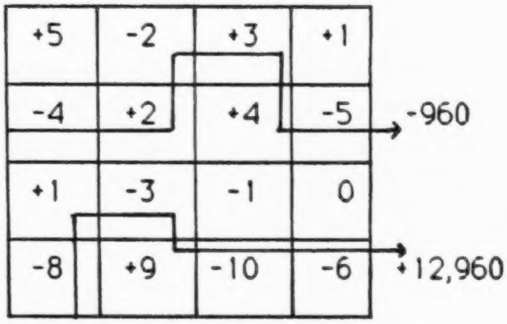
Have students give the next three entries in both patterns and formulate the rules for multiplying integers.

X-C, 07, 08; X-D, 04, 05

11. Have students follow the paths multiplying the integers crossed to find their product--using a calculator.



-6	-3	+9	+2
+4	+5	-1	-5
-2	+10	+3	-8
-4	+6	-7	+1



+5	-2	+3	+1
-4	+2	+4	-5
+1	-3	-1	0
-8	+9	-10	-6

Variation: Vary the activity using real fractions or decimals; or using rational numbers; and/or using multiplication and division.

SUPPLEMENTARY MATERIALS

SUGGESTED LIST OF MANIPULATIVES

Many of the activities in this guide involve the use of manipulatives of one kind or another. This focus is intentional as it reflects the basic philosophy that understanding of mathematics concepts should be developed concretely. The following list contains suggested manipulatives which the teacher might use to enhance the teaching of mathematics.

Counters
  straws
  beans (note: spray paint extends the useful life of beans)
  tongue depressors
  ice cream sticks
  soft drink bottle caps
  checkers
  buttons
  blocks
  colored macaroni (food coloring and alcohol)

Attribute blocks
Pattern blocks
Colored cubes
Unifix cubes
Cuisenaire rods
Tangrams
Geoboards, rubber bands

Place Value Materials
  cups
  beans
  place value blocks (units, tens, hundreds,thousands)
  place value boards:

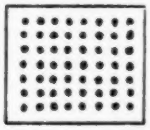
H	T	O

Paper money and coins
Protractors
Compasses
Rulers
Measuring tapes
Containers of various capacities (cup, quart, liter, etc.)

Bathroom scale
Balance scale and weights
Clocks (digital and regular)
Thermometers (Celcius, Fahrenheit)

Dominoes
Spinners
Dice, number cubes

Hundreds charts
Number lines
Grid paper, centimeter paper
Dot paper:



Three dimensional models (prisms, cylinders, cubes, etc.)

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